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Abstract: The standard tax competition literature predicts a race to the bottom in capital tax rates as capital mobility increases. Recently, the very different modeling framework of the new economic geography literature has produced the contrasting result that economic integration leads to agglomeration rents to capital which can be taxed away, in turn leading to higher corporate taxation. This paper incorporates increasing returns directly into the standard tax competition modeling framework to identify the origin of this disparity of results. The model illustrates that increasing returns reduce traditional tax competition pressures as capital mobility increases, and that changes in preferences for the public good, combined with increasing cross-border ownership of capital, and thus tax exporting incentives, are the main factors driving tax rates higher. Tax exporting has not previously been linked endogenously to capital mobility in standard tax competition models or new economic geography models.

Keywords: Tax competition; Capital mobility; Economic Geography; Increasing Returns; Tax Exporting

JEL Classification: H20; F12; F15

1. INTRODUCTION

The main result of the standard tax competition literature is that source taxes on mobile capital will be competed downward when interregional capital mobility increases – the so-called "race to the bottom" result[1]. However, capital taxes do not seem to have decreased during the last few decades in spite of the surge in capital mobility among advanced industrial nations. Devereux et al. (2002) show that while statutory tax rates have been falling, the average tax burden on capital did not decrease in the EU and G7 countries over the last few decades. Adding to this is that studies estimating correlations between measures of capital mobility and the tax burden on capital for OECD country panel data find no support for tax competition[2]. Quite the opposite, some of these studies have found significantly positive relationships between capital mobility and the tax burden on capital.

The explanation of the mismatch between theory and empirics in the field of capital tax competition could of course be entirely empirical in nature, due to the significant difficulties linked to accurately measuring unobservables such as tax burdens and capital mobility. But the source of the mismatch could also be rooted in shortcomings of theory. Several extensions to the standard tax competition modeling framework have been proposed as explanations of the mismatch between empirical evidence and theoretical predictions, notably political economy mechanisms as counteracting forces to the tax competition game[3], and tax exporting effects stemming from increased international diversification of ownership of economic activity[4]. Such proposals have more or less smoothly been incorporated into the standard tax competition model,

[1] See Wilson (1999) for a review of the standard tax competition literature.
[2] Examples are the results obtained in Quinn (1997), Swank (1998) and Garreth and Mitchell (2001).
[3] See for example Persson and Tabellini (1992).
[4] See for example Huizinga and Nielsen (1997)

and some – notably the tax exporting hypothesis – have been tested and supported empirically[5]. More recently, the theoretical result of a race-to-the-bottom in tax rates has been challenged from an entirely different angle. Rather than extending or modifying the standard tax competition model to allow for features of the economy which would counteract a race to the bottom, the new economic geography literature takes as a starting point an entirely different theoretical framework for analyzing tax competition issues, focusing on the effects of complex agglomeration forces on economic integration and taxation. The resulting predictions for tax rates depend on the interaction between numerous features of the model, as well as the starting point of the interregional allocation of mobile factors are as such less clear-cut and more diverse than those of the standard tax competition literature. The particular result in focus here, which could be part of the explanation for the empirical lack of tax competition pressures on capital tax rates, is that economic integration may lead to a higher degree of concentration of economic activity in fewer regions, in turn allowing for the realization of agglomeration rents to capital in these regions which are discretely higher than in regions with less economic activity. Due to this discrete difference in the return to capital across regions, small changes in the after-tax return to capital in high-return regions will not trigger an outflow of capital as long as the return is still smaller everywhere else. Capital therefore in a sense becomes a "quasi-fixed" factor in agglomerated regions, which – within certain limits – can be taxed without triggering an outflow of capital. The possibility of taxation of agglomeration rents may hence result in higher taxation of capital when economic integration increases, rather than a race to the bottom.

[5] Eijffinger and Wagner (2002) test and find the tax exporting hypothesis significant using firm level data for US states, but the hypothesis has not been tested as an explanatory factor in panel regressions on macroeconomic data, nor for EU data.

The differences in the assumptions of the standard tax competition model and the new economic geography modeling framework makes comparison of the results and attribution of the deviation of the results to particular characteristics of the models tricky. To get around this problem, this paper shows that the specific results regarding taxation of agglomeration economies and tax competition of the new economic geography literature can be obtained in the standard tax competition modeling framework by simply incorporating external economies of scale on the regional level combined with maintaining the assumption of perfect competition on firm level. This allows for accumulation of productive factors in one location to lead to external – or agglomeration – economies, which can be taxed without distorting the allocation of capital.

As a bonus in this exercise, including increasing returns and the resulting asymmetric allocation of capital in equilibrium in the model allows the modeling of changes in cross border ownership of capital, and thus tax exporting incentives, endogenously, as indirectly dependent on the degree of capital mobility. The model moreover allows for increasing concentration of economic activity and the resulting economies of scale, and higher income in turn leads to changes in the preferences for the public good which also affect optimal capital tax rates. These two rather intuitive effects of increasing economic integration on taxation have not earlier been included endogenously in the tax competition game in the standard tax competition literature, nor have they previously been considered as part of the determination of tax rates in economic geography models[6].

[6] Huizinga and Nielsen (1997) consider the degree of foreign economic ownership exogenously. The lack of tax exporting incentives for taxation of capital owned by foreigners in new economic geography models is largely due to the specification of government objective functions in this literature, which is generally different from the objective of the representative household.

The paper is structured as follows. The next section presents the setup and central results of the two-region version of the standard workhorse tax competition model. Section 3 reviews the recent results concerning capital income taxation derived from the new economic geography literature, and incorporates these arguments into the framework of the standard two-region tax competition model. The final section concludes.

2. THE STANDARD MODEL OF TAX COMPETITION

The basic tax competition model by Zodrow and Mieszkowski (1986) investigates the effects of capital mobility on capital income taxation in a simplified framework for an infinity of identical regions, and concludes that capital mobility leads to lower tax rates and sub-optimally low levels of public good provision. A two-region version of the standard tax competition model is taken as a starting point here, in order to simplify the comparison with two-region new economic geography models.

a. The Model

Two identical regions, which together form the world or a separate region within the world, each have three sectors: production, the household sector and the public sector. There are two inputs in production: mobile capital and a fixed factor, which can be thought of as labor. The fixed factor is supplied by the households, who hence alternatively can be viewed as owners of a production process using only capital, or as providing workers to the production process. Capital enters the production process with decreasing marginal productivity:

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

where k_i is the amount of capital per head invested in production in region i, $i = 1,2$. The amount of households in each region can be scaled to one: the representative household. The representative household in region i receives income from invested savings, $\overline{k}$, and wage income from production. The budget constraint of the representative household is thus:

$$(2) \qquad x_i = f(k_i) - f_{k_i} \cdot k_i + r \cdot \overline{k}$$

Where ? is the after-tax return to capital in region *i*. Since there is no tomorrow, the representative household will spend all its current income, hence the equality sign. The utility of the representative household depends positively on public spending and private consumption[7]:

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

The government provides the public good g, which is financed with source taxes t on capital employed within the jurisdiction of the region in question. The government budget constraint of region i is thus:

$$(4) \qquad t_i \cdot k_i = g_i$$

The government is assumed benevolent and has as strategy to choose the tax rate that maximizes the utility of the representative household subject to the government budget constraint.

b. Equilibrium under Zero Capital Mobility

If capital cannot be moved to the other region in response to a tax rate increase at home, taxation of capital is non-distortionary. In this case, using the tax rate to increase public spending by one unit will cost exactly one unit of lost private consumption. The marginal cost of public funds is equal to one. The government will hence increase the tax rate and public good provision as long as the marginal utility of the public good is higher than that of private consumption. Under zero

[7] The assumption that the utility function is separable in its two arguments simplifies the analysis and makes the model tractable, while not changing the conclusions.

capital mobility, the strategy of the government in region i will therefore be to choose the tax rate which solves the first order condition[8]:

$$(5) \qquad \frac{u_{g_i}(g_i, x_i)}{u_{x_i}(g_i, x_i)} = 1$$

c. Equilibrium under Perfect Capital Mobility

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

$$(6) \qquad k_1 + k_2 = 2\bar{k}$$

When capital is perfectly mobile, the representative household can move its capital outside the region of residence to attain the after-tax return to capital in the other region if that home net return to capital is lower. Only when the net return to capital in the two regions are equal is there no incentive to move capital between regions, and under perfect capital mobility, the interregional market is therefore characterized by the equilibrium condition:

$$(7) \qquad f_{k_1} - t_1 = f_{k_2} - t_2$$

Given the set of tax rates, the financial market equilibrium is stable and unique due to the property of decreasing marginal productivity of capital. This property is essential for the results of the standard tax competition model, and exactly what is done away with in the next section introducing external economies of scale. An increase in the tax rate in one region initially triggers a capital outflow to the other region where the net return is now higher. The outflow will result in an increase in the gross return to capital in the tax-increasing region, and a fall in the gross return to capital in the other region. The capital outflow will stop when a new equilibrium is reached

[8] Can be found by maximizing (3) subject to (2) and (4) and $k_i = \bar{k}$.

according to the financial market equilibrium condition (7). Totally differentiating (7) with respect to the tax rate gives the elasticity of capital employed in region i to region i's tax rate, and given region j's tax rate:

(8) $$e_{k_i} = -\frac{t_i}{k_i \cdot (f_{k_1 k_1} + f_{k_2 k_2})} > 0$$

How much capital has to flow out of a tax-increasing region to re-gain equilibrium hence depends on the second derivative of the production function. e_{k_i} is assumed to be smaller than one, which ensures that the economy stays on the left side of the laffer curve[9].

In the case of perfect capital mobility, an increase in the tax rate will still leave overall tax revenues higher and overall private spending lower due to the mechanisms described under the zero capital mobility case above. However, under perfect capital mobility, there are three additional distortionary effects associated with an increase in the regional tax rate. First, the associated outflow of capital lowers the gross return to the fixed factors of production and in turn magnifies the reduction in household income due to the tax increase. The second cost is the tax base erosion effect: the reduced regional employment of capital leaves less capital to tax, which has a negative effect on tax revenues. Third, due to the assumption of a finite number of regions, the capital outflow will result in a lower world net return to capital given the other region's tax rate[10]. These three 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.

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[9] 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.

[10] The third effect corresponds to the addition of $f_{k_2 k_2}$ in the denominator of the expression for the elasticity of capital to the tax rate, and is a factor mitigating the distortionary effects of capital taxation under perfect capital mobility which is not present in the Zodrow and Mierzkowski (1986) version of the model with an infinity of regions.

As each unit of tax revenue raised costs one unit of household income plus the sum of the three effects described above, an additional unit of spending on the public good costs more than one unit of forgone private spending. Now the marginal cost of public funds is greater than one.

The selection of tax rates in the two regions is carried out as a simultaneous move one-shot game in tax rates. Once tax rates are selected, capital will flow to equilibrate the net return to capital between the two regions according to (7). Both governments know how capital responds to tax changes, and assuming a Nash game in tax rates between the two regions, the governments' strategy under perfect capital mobility is to set the tax rate which maximizes the utility of the representative household, subject to the relevant budget constraints (2) and (4), the financial market equilibrium (7), and taking the tax rate of the other region as given. Thus, the first order condition for government *i*'s optimization problem under perfect capital mobility becomes:

$$\frac{u_{g_i}}{u_{x_i}} = \frac{1 - e_{k_i} \cdot \left[(\bar{k} - k_i) \cdot \frac{f_{k_j k_j}}{t_i} \right]}{1 - e_{k_i}} \qquad (9)$$

The second term of the numerator depends on whether the region is a capital importer or exporter. In the symmetric Nash equilibrium, each region will employ $\bar{k}$ amount of capital. The capital accounts of the two regions will balance and the two income effects will cancel out, leaving only the tax base effect:

$$\frac{u_{g_i}}{u_{x_i}} = \frac{1}{1 - e_{k_i}} \qquad (10)$$

where $\frac{1}{1-e_{k_i}} = MCPF$ is the marginal cost of public funds, which is always larger than one when the elasticity of capital with respect to the tax rate is positive. The government will hence select a tax rate which ensures that the marginal cost of increasing public spending by one unit, the *MCPF*, is equal to the marginal utility increase of shifting resources from private spending to public spending through a distortionary 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.

This tax-setting behavior leads to a downward spiral in tax rates when capital becomes mobile, referred to as a “race to the bottom” in tax rates. 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 with the benefit of the capital inflow that such a decrease would entail in both regions. 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. If the two regions were to engage in a coordinated marginal increase in the tax rate, this would not affect the international allocation of capital, but would reallocate resources from private to public spending within each region, thus increasing the utility of the representative household in both regions. Moving from an uncoordinated to a coordinated equilibrium would hence be pareto-improving.

To conclude, the prediction of the standard model of tax competition regarding capital taxation is hence that regions will increasingly compete for productive capital when capital mobility increases, by lowering the tax rates on capital. Capital mobility is hence predicted to be associated with lower capital tax rates, the so-called race-to-the-bottom result.

3. INCREASING RETURNS

The new economic geography literature on tax competition allows for situations where economic integration does not lead to a race to the bottom, as described in the introduction. Using economic geography models with mobile skilled labor and immobile unskilled labor, Ludema and Wooton (2000), followed by Andersson and Forslid (2003) and Baldwin and Krugman (2003), point out the possibility of taxation of the mobile labor under the presence of agglomeration rents, without triggering an outflow of this factor to other regions. More in line with traditional tax competition models, Kind et al. (2003) and Ottaviano and Van Ypersele (2002) assume that the mobile factor is capital and allow for the returns to this factor to be spent in the location of the owner rather in the location where the factor is employed. They find that when all economic activity is agglomerated in one region, the return to capital in that region is higher than the potential return to capital in the other region, and this cross-regional difference allows for positive taxation of capital in the region hosting the agglomeration without giving an incentive for capital to flow out. Additionally, most new economic geography studies find that if production activity is not completely clustered in one of the two regions, the governments 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 standard tax competition models allowing for the lump sum taxation of a second production factor[11]. New economic geography models hence predict a U-shaped relationship between the degree of economic integration and capital tax rates: as regions start to integrate, integration initially reduces tax rates through tax competition mechanisms. But as economic activity concentrates in one location, responding to and further producing agglomeration economies, tax rates are increased again since taxation of agglomeration economies are non-distortionary within limits.

[11] See for example Razin and Sadka (1991)

The concept of economic integration is more complex in new economic geography models relative to the standard tax competition model, in which it refers solely to the mobility of capital. The degree of economic integration in the new economic geography model is a composite, depending on the interaction between the assumed mobility of factors, assumed level of trade cost, firm relocation cost etc., and is as such not explicit in the model. For example, while holding the relocation cost of real capital fixed, decreasing trade cost will increase the degree of economic integration and in turn shift the economy from the downward sloping to the upward sloping part of the U-shaped relationship mentioned above. For this reason, as well as due to the other many differences between the standard tax competition model and new economic geography models, the prediction of the two modeling frameworks are rather difficult to compare. This problem is circumvented when external economies are implemented into the standard tax competition modeling framework of the previous section, at the cost of a reduction in the many nuances of new economic geography models, however. Since the downward sloping part of the U-shaped relationship between economic integration and tax rates is already captured in a simplified form by the standard tax competition model, this analysis focuses on implementing the upward-sloping part in the standard tax competition model

a. Allowing for agglomeration forces in the standard tax competition model

Assume that capital is the only input in production. We thus abstract from returns to fixed factors of production. This changes the expression for household income, and the change depends on the allocation of capital, and hence on the outcome of the model, as will be discussed further below. As a proxy for agglomeration economies, assume increasing returns to capital by assuming a positive second derivative of the economy-wide production function. In this way, agglomeration economies are proxied by external economies of scale of the aggregate production function:

(11) $$y_i = f(k_i), \qquad f(0) = 0;\ f'(k) > 0;\ f''(k) > 0$$

Meanwhile, on the micro level, each firm is assumed to still perceive to be in a perfect competition environment[12], and the no-profit condition is assumed to hold for individual firms. A unit of capital is hence paid its average product:

(12) $$R = \frac{f(k_i)}{k_i}$$

where R is the gross return to capital. In all other respects, the framework is the same as in the standard model. In particular, it is also assumed here that that the produced good is traded freely between the two regions at no cost and, hence, that regional production does not have to equal regional consumption. This assumption is implicit in the standard tax competition model where equilibria between equally sized regions are symmetric with zero trade, but becomes central in the present setup, since trade accounts do not balance (rather, the current account balances) in the asymmetric equilibrium as shown below.

b. Equilibrium under zero capital mobility

When capital is assumed immobile, each region will use its own endowment of capital in production, and taxation of capital is non-distortionary. The objective of the government is identical to that of the standard model in the previous Section: select a tax rate which maximizes the utility of the representative household given the relevant budget constraints. Thus, for the same reasons as under zero capital mobility in the standard model, capital will be taxed optimally according to the first order condition of the closed economy, (5). The tax rate will be increased as long as the marginal utility of public goods is higher than that of private spending, and vice versa, as the marginal cost of public funds is equal to one.

[12]Since the two regions are identical in terms of factor endowment, it does not matter whether a per capita representation or an aggregate representation is used.

c. Equilibrium under perfect capital mobility

Under perfect capital mobility, the external economies version of the model differs in an important respect with regard to the standard model: Under the assumption of external economies of scale, a capital flow from one region into the other region does not have the equilibrating effect of increasing the net return to capital in the region of origin of the capital flow and decreasing the net return in the recipient region, as in the standard model. On the contrary, a capital flow in response to a net return differential will increase the net return differential and create stronger incentive for further capital flows. In this environment, the tax competition game unfolds as follows. First, the governments simultaneously choose the tax rate which maximizes the utility of their representative households, while taking the tax rate prevailing in the other region as given. Second, if there is a net return differential between the two regions, capital will flow to the region with the highest relative net of tax return to capital until all capital is agglomerated in that region. If there is no net return to capital differential, no capital flows will take place. There are two candidates for a Nash equilibrium in tax rates in this setup, depending on the starting point of the game. The first candidate for an equilibrium derives from the starting point of a core-periphery allocation of capital, in which all capital is invested in one region while the other region is living of the repatriated earnings from capital invested abroad. This equilibrium is stable, and will henceforth be called the core-periphery equilibrium following the economic geography terminology. If, on the other hand, the game starts in a situation of a symmetric allocation of capital, the candidate equilibrium will also be symmetric in the allocation of capital. This symmetric outcome is unstable, however, and does not exists as a Nash equilibrium in pure strategies. The symmetric equilibrium is hence delegated to appendix and not considered any further here.

In the core-periphery starting point of the game, all capital is invested in the production of one region - the core - while the other region – the periphery - does not have any production at all. The net of tax income of the representative household in both regions derives from returns to capital invested in the core, and is given by:

$$(13) \qquad x_c = x_p = \left(\frac{f(2\bar{k})}{2\bar{k}} - t_c\right) \cdot \bar{k}$$

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

$$(14) \qquad g_c = t_c \cdot 2 \cdot \bar{k}$$

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

$$(15) \qquad g_p = 0$$

The representative household of the periphery spends its net repatriated earnings from capital on imports of the private good, while there is no public good provision since there is no tax base in the periphery. In this setup, the region hosting the core is able to levy positive taxes on capital without risking to lose the core to the other region, since the difference between the gross return to capital in the core and the potential gross return to capital of the periphery is strictly positive. As long as the tax rate does not exceed this difference, the net return to capital will stay greater in the core. Assuming that the periphery sets a zero tax rate[13], the upper limit to the tax rate in the core is given by the condition (remembering that the 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.):

[13] The tax rate in the periphery does in fact not apply to any capital, since it is all invested in the core, and the tax rate in the periphery is hence not determinable in the model. Assuming a zero tax rate could be backed by the story that the periphery knows that the lower the tax rate in the periphery, the lower the upward bound on the tax rate in the core, as shown below in condition (16). Hence, a lower tax rate in the periphery would serve to reduce the scope for source based taxation of the returns to capital invested in the core by the representative household in the periphery.

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

t^{trig} is always positive since 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 instantly flow to the periphery and only if the periphery (which is now hosting the core) sets a tax rate above the t^{trig} limit will the former host of the core regain the core. Below t^{trig}, however, capital is effectively immobile, and can be taxed as if lump sum. The government of the core hence chooses the tax rate that maximizes the utility of the representative household in the core, given the budget constraints (13) and (14), and a zero tax rate in the periphery, and assuming that capital is immobile within the limit given by t^{trig}. The resulting first order condition for optimum becomes:

(17) $$\frac{u_g(x_c, g_c)}{u_x(x_c, g_c)} = \frac{1}{2}$$

Note that given an internal solution to the government's optimization problem, the core-periphery equilibrium is stable in that a small outflow of capital or a marginal increase in the tax rate in the core would not trigger further capital outflows leading to a move away from this equilibrium. Note also that if the government could transfer resources from the public to the private sector without changing the tax paid by foreigners, this would increase the utility of the representative household. Opposite to the result of under-provision of the public good in the standard model, the core-periphery equilibrium is hence characterized by over-provision of the public good.

It is now possible to identify the factors which drive the utility maximizing tax rate under the assumption of increasing returns. While tax competition pressures are absent in this model when the solution to the first order condition is internal, there are two other factors affecting capital taxation when moving from the zero capital mobility equilibrium to the perfect capital mobility core-periphery equilibrium: the income effect concerns the left hand side of the first order condition above, and the tax exporting effect concerns the right hand side. Starting with the income effect, since all capital is concentrated in the core when capital mobility is perfect, global production increases due to the external economies realized by this concentration of production. The revenues from this global production are equally split between core and periphery households, which both have higher gross income from capital. How much higher is determined by the degree of external economies of scale. Depending on the parameters of the household utility function, higher income may affect the choice of tax rate through changes in relative preferences for the public good. If the preferences represented by the utility function conform with Wagner's Law, the public good should be viewed as a luxury good and the demand for the public good should increase relative to private goods as income increases. In this case, the income effect should have a positive effect on capital taxation. But the effect could also be neutral (as in the example below) or even negative. Second, the right hand side of (17) shows that the marginal cost of public funds is perceived by the government to be one half. For every unit of tax revenues raised, only half of that unit comes from a decrease in household consumption. The other half is paid by the foreign capital owner, which entails that the marginal cost of public funds is below unity from the viewpoint of the policy maker in the core, who does not care about the household in the periphery. Hence, there is a tax exporting effect resembling that analyzed in standard tax competition models such as Huizinga and Nielsen (1997), which should result in a higher capital tax rate all else equal. In Huizinga and Nielsen (1997), the degree of foreign ownership of capital is set exogenously, and is hence independent of the degree of capital mobility. The present setup thus takes a step further in allowing for tax exporting as a countervailing force to tax competition, in that the tax exporting effect is endogenous and linked with the degree of capital mobility.

Whether or not capital taxes are increasing in the degree of capital mobility hence depends on how strong tax exporting incentives are, and what happens to the households' preferences for provision of the public good relative to private consumption, rather than the increasing returns per se. Increasing returns in themselves do not explain why the tax rate is higher, only why it is not competed downward. The net effect of the two factors listed above depend on the parameters of the model. It is therefore not possible to a priori identify whether the utility maximizing tax rate is higher in the core periphery equilibrium compared to the tax rate in the no capital mobility situation. The assumption of a homothetic utility function would be sufficient to ensure that tax exporting would lead to a higher tax rate under perfect capital mobility though. To form an idea of the impact of capital mobility on capital taxes in the external economies of scale version of the standard tax competition model, a simple example with functional forms is given.

An example with functional forms

Suppose that production is characterized by a quadratic production technology and that the preferences of the representative household are represented by a log-linear utility function as follows:

$$f(k) = \frac{1}{2}k^2 \tag{18}$$

$$u(x,g) = \ln(x) + w \cdot \ln(g) \tag{19}$$

where ω is a positive weight attached to public spending. Note that the income effect is neutral in this example, since the chosen form of the utility function implies that the optimal relative allocation of resources between private and public spending is independent of the level of income. The tax exporting effect remains.

Starting with the case of zero capital mobility, government spending and private net income are:

$$(20) \qquad x_{ncm} = \frac{1}{2}\overline{k}^2 - t_{ncm} \cdot \overline{k}$$

$$(21) \qquad g_{ncm} = t_{ncm} \cdot \overline{k}$$

where the ncm subscripts denote the no capital mobility case. Differentiating utility, (19), with respect to income and public good provision, and using the budget constraints, (20) and (21), and the first order condition under zero capital mobility, (5), the equilibrium capital tax rate in both regions becomes:

$$(22) \qquad t_{ncm} = \frac{1}{2} \cdot \frac{w}{1+w} \cdot \overline{k}$$

Turning now to the case of perfect capital mobility and the core-periphery case, private net income is the same in both locations when all capital is agglomerated in the core. Moreover, government revenues are zero in the periphery as shown above while positive in the core:

$$(23) \qquad x_c = x_p = \overline{k}^2 - t_c \cdot \overline{k}$$

$$(24) \qquad g_c = t_c \cdot 2\overline{k}$$

$$(25) \qquad g_p = 0$$

$$(26) \qquad t_p = 0$$

(26) is just a reminder that the tax rate is assumed zero in the periphery. Given an internal solution to the utility maximization problem, the optimal tax rate in the core is found using the first order condition (17):

$$(27) \qquad t_c = \frac{w}{1+w} \cdot \bar{k}$$

Since $t^{trig} = \bar{k}$ is higher than the tax rate given by (27), the solution is indeed internal[14]. Thus, in this example of log linear utility and quadratic production, the tax exporting effect makes the tax rate on capital double in the core compared to the situation of zero capital mobility. The capital tax rate falls to zero in the periphery (per assumption), but this tax rate is of no importance to the tax burden on capital since all capital is taxed in the core. Thus, in the present modeling setup, a shift from zero to perfect capital mobility is associated with a doubling of the overall tax burden on capital. What happens is that increasing returns create agglomeration rents which allow taxation of capital without distorting the allocation of capital, and the inflow of capital from the periphery creates tax exporting incentives to set a higher tax rate than is the case when capital is not mobile.

4. CONCLUSION

This paper has incorporated a central feature of the new economic geography literature regarding tax competition – namely that economic integration leads to agglomeration rents to capital which can be taxed non-distortionarily – into a simple standard tax competition model. Several insights emerge from this exercise.

To begin with, the result of a positive relationship between tax rates and the degree of capital mobility in the presence of increasing returns can be obtained from within the standard tax

[14] The t^{trig} is found by inserting the functional form of the production function in (16).

competition literature, using a simple two-region one-period standard model of tax competition with only a few but important modifications.

Moreover, the exercise allows an attribution of the different results of the two literatures to specific assumptions of the model. First of all, increasing returns cut the link between economic integration and distortionary effects of capital taxation by producing taxable agglomeration rents to capital, hence nullifying tax competition pressures, but does not drive the increase in tax rates per se. Instead, whether capital taxes will be higher under perfect capital mobility than under zero capital mobility depends on tax exporting incentives and household preferences for public good provision, which both change as capital flows into the agglomerated region and income increases. Tax exporting as an incentive for taxation is absent in the new economic geography literature on tax competition (and would be an interesting area of extension). Moreover, the degree of foreign ownership of capital, and thus capital tax exporting effects, have not previously been incorporated endogenously into the standard tax competition modeling framework.

The predictions emerging from this modified standard tax competition model furthermore match previous empirical evidence, that the capital tax burden has not increased in most OECD regions in the recent decades, that there is no statistically significant negative link between capital mobility and capital taxation to be found, but that there is support for tax exporting effects to have a positive effect on capital tax burdens.

The findings imply that the answer as to whether or not capital tax competition is intensifying due to regional or global economic integration, with adverse consequences for tax revenues and the tax mix, may depend strongly on the degree of economies of scale in sectors or industries in which capital taxes are levied at the source. Where there is a prevalence of increasing returns, tax policy may increasingly be seen to be shaped by tax exporting incentives as capital flows into centers of economic activity, as well by changes in the preferences for public good provision as income levels rise, rather than tax competition forces.

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5. APPENDIX

Initial symmetric allocation of capital and tax competition

Consider the game described in Section 3 when it sets off in a starting point with a symmetric allocation of capital. Given an initial symmetric allocation of capital between the two regions, the government's problems looks as follows:

$$
\begin{aligned}
&\underset{t_i}{Max} \quad U(x_i, g_i) \\
&s.t. \\
&a. \quad x = \left(\frac{f(\bar{k})}{\bar{k}} - t_i\right)\bar{k}, \quad g_i = t_i \cdot \bar{k} \quad \forall t_i = t_j \\
&b. \quad x = \left(\frac{f(2\bar{k})}{2\bar{k}} - t_i\right)\bar{k}, \quad g_i = t_i \cdot 2\bar{k} \quad \forall t_i < t_j \\
&c. \quad x = \left(\frac{f(2\bar{k})}{2\bar{k}} - t_j\right)\bar{k}, \quad g_i = 0 \quad \forall t_i > t_j
\end{aligned}
\tag{28}
$$

Since the distribution of capital is now “lumpy”, the expressions for the private and government budget constraints depend on the allocation of capital, which in turn depends on the tax rates chosen by the two regions. If region *i* sets a lower tax rate than region *j*, region *i* will win the core, i.e. attract all the capital to region *i* (case *b* in (28)). The opposite holds true if region *i* sets a higher tax rate than region *j* (case *c*). If the two regions choose the same tax rate, the outcome will be a symmetric allocation of capital (case *a* in (28)). A possible Nash equilibrium must be symmetric in tax rates and in the allocation of capital, since the two regions are identical and hence will choose the same tax rate. Consider first whether a symmetric set of strictly positive tax rates could constitute a Nash equilibrium. In a Nash equilibrium, it must be the case that there is no utility gain to be had in any of the two regions from marginally lowering the tax rate and thereby attracting all capital to the region[15]. The gain from marginally reducing the tax rate and attracting the core derive from two sources: First, from realizing higher private income through external economies taxed at a lower rate, and second, from the doubling of the tax base given the tax rate (marginal effect on tax revenues). The cost of a tax cut stem from the reduction in tax revenues from infra-marginal units of capital due to the marginally lower tax rate - the infra-marginal effect on tax revenues. Now, note that in a starting point of strictly positive symmetric tax rates, it is always possible to marginally lower the tax rate by less than one half, implying that the infra-marginal effect can always be contained to less than one half of the overall tax revenues. Since attracting the core entails a doubling of the tax base, this means that it is always possible to increase the overall tax revenues through a tax cut, irrespective of the initial level of the symmetric set of tax rates. Since private net income is always increased through a tax cut, this implies that a tax cut can always be chosen such that it will improve welfare, in turn implying that a set of symmetric and strictly positive tax rates cannot be a Nash equilibrium. This leaves

[15] This automatically implies that there is no utility gain to be had from marginally increasing the tax rate and thereby triggering an agglomeration in the other region.

the situation of zero tax rates, in which it is not possible to cut taxes any further. But given a zero tax rate in the other region and symmetry, it will always be beneficial to increase the tax rate and thereby chasing the core to the other region, in turn increasing private net income through the realization of external economies of scale. So the symmetric zero-tax situation is not a Nash equilibrium either. In consequence, a symmetric Nash equilibrium does not exist when the starting point is a symmetric allocation of capital. Finally, note that there may be an equilibrium in mixed strategies, which is not pursued any further here.