INTRA-REGIONAL TAX COMPETITION AND ECONOMIC GEOGRAPHY

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Abstract

We extent a solvable version of the core-periphery agglomeration model to four countries located in two regions. The paper shows that there might still be a race to the bottom in capital income tax rates despite agglomeration rents earned by the mobile factor. We find that intra-regional tax competition is detrimental from a welfare perspective and that tax harmonisation unambiguously makes both countries in the core region better off.

JEL Code: F12, H87.

Keywords: tax competition, economic geography, race to the bottom.

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1 Introduction

Recent applications of economic geography models to tax competition have modified the neoclassical race-to-the-bottom result. In case of full agglomeration, capital might earn a premium that can be taxed by local authorities without any distortions. This agglomeration rent makes the mobile factor quasi-inelastic for a certain range of trade costs so that tax rates on capital income might rise in line with deepened market integration. This argument has been made by Ludema and Wooton (2000), Kind et al. (2000) and Baldwin and Krugman (2004). Borck and Pflüger (2006) show that this result also holds in a framework with partial agglomeration equilibria.

It is reasonable to consider tax competition in a new economic geography framework as economic activity is certainly not evenly spread across space in reality. This might provide a sound argument for why we should not observe a downward trend in tax burdens on corporate income. However, stylised facts seem to underline the neoclassical tax competition result with effective average tax rates on corporate income having fallen over the recent 25 years. This paper provides an explanation for why there might still be a race to the bottom despite the existence of agglomeration rents.

We extend the basic new economic geography setup by considering two symmetric regions that consist of two jurisdictions (countries) each. This leads to a situation in which a single jurisdiction within the agglomerated region cannot skim off the rents of the mobile factor as long as tax policies are not coordinated. Such a scenario is pretty likely for many real world phenomena. Baldwin and Krugman (2004), for instance, view Belgium, the Netherlands, Luxembourg, Germany, France and the UK as the European core whereas the surrounding countries can be referred to as the periphery. Another example would be the agglomerated eastern border region of Canada and the US. Here, marginal tax differences might cause firm movements since alternative locations within this core offer to serve the same market at the same cost. This interpretation can be extended to a more disaggregated level, for example, tax competition between municipalities or counties.

The next section provides some stylised facts about recent trends in corporate income taxation. Section 3 introduces the economic geography model and lays out its features without tax competition. In section 4, we discuss optimal tax policy in the absence of capital mobility to derive a benchmark case. We continue to analyse the tax game before we discuss the implications of tax harmonisation. Section 5 concludes.

2 Stylised facts

A first look at statutory tax rates on corporate income unambiguously reveals a downward trend over recent decades.[1] However, corporate tax revenues as a share of GDP stayed rather constant in most OECD countries or even went up in some cases. Baldwin and Krugman (2004) interpret this share as a measure for the average corporate tax rate and take it as evidence that there is no race to the bottom. But the trend in corporate tax revenues as a percentage of GDP might be a misleading measure of tax competition if the share of corporate profits in GDP has changed over time. Indeed, Sorensen (2007) provides some evidence that corporations became more dominant as an organisational form so that the share of corporate profits in GDP went up in recent years. Hence, this simplified measure cannot capture the true tax burden. It is more reliable to directly look at effective average tax rates on corporate income.[2] As Figure 1 demonstrates, the effective average tax rates show a clear downward trend in the tax burden. In 2003, only Ireland and Canada imposed a higher effective average tax rate relative to 1982.

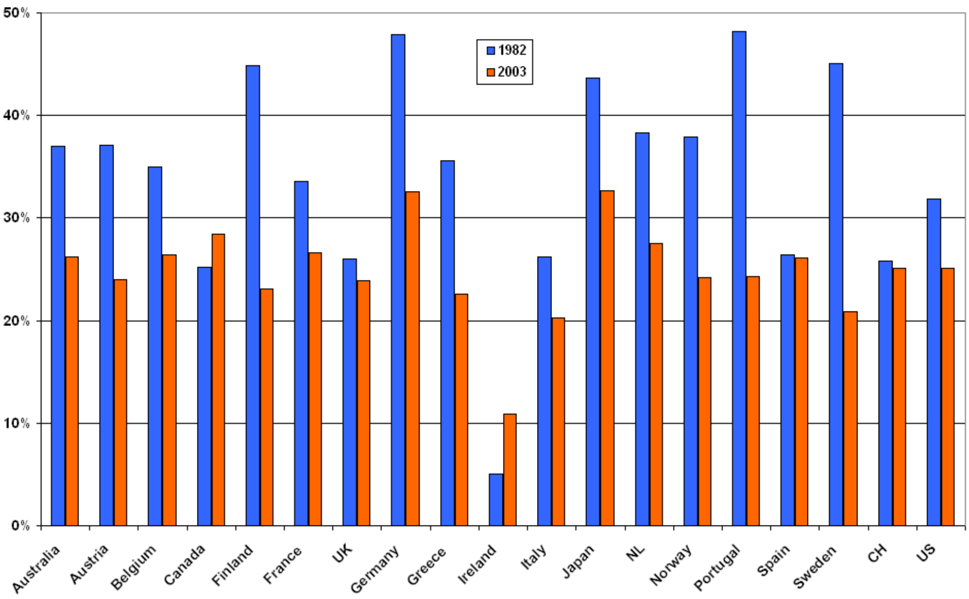

Figure 1: Effective average tax rates on corporate income (IFS, 2007)

[1] According to data from the Institute for Fiscal Studies at www.ifs.org.uk.

[2] Devereux et al. (2002) argue that the effective average tax rate is the relevant reference for discrete investment decisions.

With economic activity being unevenly spread across space we should address the puzzle why rents from agglomeration do not seem to be taxed away in reality. It is this paper's task to provide an answer to this question.

3 Model

We employ an analytically tractable variant of the Krugman (1991) core-periphery model due to Forslid (1999) – also referred to as the footloose entrepreneur model. We extend the framework to four symmetric countries being located in two regions, North and South. Each region accomodates two countries 1 and 2 and we denote Southern countries by an asterisk. Symmetry refers to endowments, tastes and technology. However, trade costs are asymmetric in the sense that they might take any value between regions, but they are zero within. All countries are endowed with capital (K) and labour (L) producing two goods, a homogeneous traditional good (Y) and an industrial composite good à la Dixit-Stiglitz (X).

Preferences. Consumer preferences can be summarised by a two-tier utility function. The upper tier is Cobb-Douglas whereas preferences for the composite industrial good can be described by a CES-function defined over all varieties such that

$$U_i = C_{Xi}^{\mu} C_{Yi}^{1-\mu}, \qquad C_{Xi} = \left(\int_{m=0}^{n^w} c_{mi}^{1-1/\sigma} dm \right)^{1/(1-1/\sigma)}. \tag{1}$$

C_{Xi} and C_{Yi} denote aggregate demand for the composite and the traditional good, respectively. The income share households dedicate to manufacturing goods is μ, n^w characterises the mass (number) of varieties in all countries and $\sigma > 1$ is the constant elasticity of substitution between any two varieties. The demand for a manufactured variety in country i is denoted by c_{mi} including both domestic and foreign supply.

Utility maximisation yields demand functions for the two aggregates as well as for each variety

$$\begin{aligned} C_{Xi} &= \mu E_i / P_i, \qquad \text{with} \quad P_i = \left(\int_{m=0}^{n} p_m^{1-\sigma} dm + \tau \int_{m=n}^{n+n^*} p_m^{1-\sigma} dm \right)^{1/(1-\sigma)} \\ C_{Yi} &= (1-\mu) E_i / p_Y \\ c_{mi} &= \begin{cases} \frac{p_m^{-\sigma}}{P_i^{1-\sigma}} \mu E_i & \text{for Northern varieties} \\ \frac{(\tau p_m)^{-\sigma}}{P_i^{1-\sigma}} \mu E_i & \text{for Southern varieties,} \end{cases} \end{aligned} \tag{2}$$

where P_i is the price of the composite industrial good, p_Y the price for the Walrasian commodity and E_i expenditure in country i. In equilibrium, all firms charge identical mill prices p_m. We adopt the common assumption that only cross-border transactions of X are impeded by iceberg trade costs. Accordingly, firms have to ship τ units of any variety for one unit to arrive at its final destination. Hence, consumer prices for foreign and domestic manufactured varieties differ by the magnitude of the iceberg trade cost τ. We choose Y as numéraire and restrict our analysis to configurations in which the traditional good is produced in each country. With zero trade costs in Y it follows that $p_Y = 1$ everywhere.

Technology. Production of the traditional good requires one unit of labour per unit of output. With zero trade costs for Y, intersectoral mobility of workers, and $p_Y = 1$, it follows that wages are equated to unity across borders. Firms in the monopolistic competition sector require both capital and labour for production. Capital is only needed to set up a firm and workers constitute the variable input. In order to produce x units of any variety, the firm faces costs of $r + a_X x$, where r is the cost of capital and a_X denotes the unit labour requirement. This generates increasing returns to scale implying that any single variety is only produced by one firm. Firms charge prices as a constant mark-up over marginal costs such that

$$p = \frac{a_X}{1 - 1/\sigma}.$$

The profit function for any firm in the industrial sector is

$$\pi_m = (p - a_X)\, X_m - r = X_m/\sigma - r,$$

where X_m represents total demand for any variety produced in country i. Free entry of firms ensures that pure profits are driven down to zero in equilibrium.

Short-run equilibrium. Employing the zero profit conditions jointly with optimal demand allows us to calculate the return to capital as

$$r_1 = r_2 = \frac{\mu}{\sigma}\left[\frac{E_1 + E_2}{n_1 + n_2 + \phi n_1^* + \phi n_2^*} + \phi \frac{E_1^* + E_2^*}{\phi n_1 + \phi n_2 + n_1^* + n_2^*}\right] \tag{3}$$

and

$$r_1^* = r_2^* = \frac{\mu}{\sigma}\left[\frac{E_1^* + E_2^*}{\phi n_1 + \phi n_2 + n_1^* + n_2^*} + \phi \frac{E_1 + E_2}{n_1 + n_2 + \phi n_1^* + \phi n_2^*}\right],$$

where $\phi \equiv \tau^{1-\sigma}$ is a measure of the freeness of trade with $\phi \in [0, 1]$. When $\phi = 0$ trade costs are prohibitively high and there are no barriers when $\phi = 1$. Note that capital owners earn the same reward within a region, no matter in which country they reside. The reason is that trade costs are zero within regions so that we can regard countries within a region as one common market. The ns denote the number of firms that operate in the respective countries.

Long-run agglomeration pattern. Capital moves to the country that offers the highest utility – that is the highest real reward net of taxes. Although symmetry ensures that capital returns are identical in all countries in autarky, the footloose entrepreneur model features agglomeration forces that dominate the dispersion force if trade costs are sufficiently low. Thereby, initial symmetry might collapse so that full agglomeration of the mobile factor accrues in one location. We can illustrate two of the forces at work with the help of (3). First of all, a higher level of expenditure in one country influences capital returns positively (at a given n). This is referred to as the *market access effect* favouring agglomeration. The counterforce – the *market crowding effect* – is reflected in the denominator. A higher number of firms ceteris paribus decreases capital returns as firms compete more severely for the relatively scarce labour force. Finally, as capital owners care about real rewards, the *price index effect* always works in favour of agglomeration as well. Living in the larger market implies that fewer varieties have to be imported which saves transport costs.[3]

Full agglomeration of capital generates specific rents for the mobile factor. This so-called agglomeration rent measures the capital return differential between the return in the agglomerated region and the return capital would earn if it would be relocated to the periphery. This literally locks in the mobile factor for sufficiently low levels of ϕ as it does not pay off to move to the periphery.[4] Formally, we can write

$$\Omega^C = \left.\frac{r_i/P_i}{r_i^*/P_i^*}\right|_{s_n=1} = \frac{\phi^{1-\mu/(\sigma-1)}}{1-\left(1-\phi^2\right)\left(1+\mu/\sigma\right)/2}, \tag{4}$$

where s_n denotes the share of firms operating in the Northern region.[5] The agglomeration rent Ω^C is bell-shaped in ϕ. If ϕ exceeds a threshold ϕ^S (sustain point), full agglomeration renders a stable equilibrium and Ω^C exceeds unity (less than unity otherwise). If trade is unrestricted ($\phi = 1$), location does not matter and $\Omega^C = 1$. In the remainder of the paper, we focus on full agglomeration of manufacturing in the Northern region.

[3] See Baldwin et al. (2003), Baldwin and Krugman (2004) and Forslid (1999) for a more detailed discussion of these effects.

[4] We implicitly assume here that firms behave in an uncoordinated manner. Of course, a simultaneous move of all firms to the periphery ensures the same agglomeration rent and thus the same real income.

[5] See Baldwin and Krugman (2004).

4 Taxation

4.1 Autarky

We assume that the government can set the capital income tax independent of the labour income tax and exclude the latter from our analysis. Tax rates are weakly positive, i.e. we do not allow for capital subsidies. Gross tax revenue is then given by $G = trK$. We assume that the social welfare maximising government cares about tax revenue and the consumption of its citizens. Furthermore, given any size of government and consumption level the authority prefers lower taxes to higher taxes. Formally, we have $W = W(G, C, t)$, with $W_G > 0$, $W_C > 0$ and $W(\bar{G}, \bar{C}, t) > W(\bar{G}, \bar{C}, t')$ if $t < t'$. To ease notation we write $W(G, C)$. Consumption equals total income, $C = (1-t)rK + L$. The government welfare function W is assumed to be concave in t such that there is a maximum for some $t \in (0, 1)$ in the absence of relocation concerns.[6] The properties of our government welfare function, especially concavity in t, are akin to those in Baldwin and Krugman (2004) and Borck and Pflüger (2006). The optimal tax rate in autarky is thus defined as

$$t^a \quad : \quad \frac{\frac{\partial W(t=t^a)}{\partial G}}{\frac{\partial W(t=t^a)}{\partial C}} = 1 \tag{5}$$

Result 1. *In autarky core countries set their capital income tax to some strictly positive t^a.*

4.2 Tax competition

We follow Baldwin and Krugman (2004) in modelling the tax-setting behaviour as a two-stage game of complete but imperfect information. While the core and the periphery set their taxes sequentially with the core moving first, both tax authorities within one region set their taxes simultaneously.[7] Table 1 summarises the timing.

Stage 1:	Northern countries set their taxes t_1, t_2
Stage 2:	Southern countries set their taxes t_1^*, t_2^*
Stage 3:	Firms choose their location

Table 1: Timing

[6] Formally, this requires $W_G(0, rK + wL) - W_C(0, rK + wL) > 0$, $W_G(rK, wL) - W_C(rK, wL) < 0$, $W_{GG} < 0$ and $W_{CC} < 0$.

[7] Our government welfare function allows us to solve the simultaneous Nash game as well. We discuss the differences between the simultaneous and the sequential game in more detail later in this section.

This structure and all actions in the past are common knowledge. At stage 3 we assume that capital can costlessly relocate to maximise its after-tax return. If after-tax returns are equal within the core and the core remains in the North we assume that the initial distribution of capital persists, i.e. $K_1/K^w = \gamma$, $0 < \gamma < 1$. If after-tax returns are equal across regions we assume that the core stays in the North.[8] Lastly, if the South becomes the new core and after-tax returns are equal in that region, we assume that $K_1^*/K^w = \gamma^*$, $0 < \gamma^* < 1$. These assumptions on the distribution of capital in case of identical after-tax capital returns are without loss of generality since any distribution with positive capital in both countries is included.[9]

We solve the game by backwards induction. At stage 2 the Southern countries set their tax rates. We can distinguish between two scenarios: First, if the lowest tax rate in the North $t = min\{t_1, t_2\}$ does not exceed some t^e the core will remain in the North. To see this we define the excess capital return an individual Northern firm faces (relative to being employed in the South) with given taxation. To facilitate notation we drop subindices when discussing tax competition across regions. The unindexed variables t and t^* can be thought of as the respective regional minima. The condition for the core to remain in the North is then

$$\frac{1-t}{1-t^*}\Omega^C > 1.$$

The agglomeration rent Ω^C reflects the advantage of producing in the core rather than in the periphery as defined in (4). Capital taxation in the two regions amends this trade-off. The (defense-) tax t^e defines the maximum tax rate the North can set without fearing to loose the core to the South, if Southern taxes were set most aggressively, i.e. to zero. Thus, $t^e = 1 - \frac{1}{\Omega^C}$. If the core remains in the North, the Southern economies have no tax base for capital taxation. Consequently, they set a tax $t_i^* = 0$ whenever the minimum tax charged in the North is less then t^e.

Second, we have to analyse how the Southern countries set their tax rates if there is the option of stealing the core? Note that both countries will be unambiguously better off if they attract some industry, since $W(t_i^* r_i^* g K^w, r_i^* g K^w + L_i^*) > W(0, L_i^*)$ with $g \in \{\gamma^*, 1-\gamma^*\}$ holds for all $t_i^* \geq 0$. Hence, attracting the core is even desirable if it requires to set the capital tax to zero. This is indeed the case, since any marginal undercutting of the other Southern tax authority's positive tax rate would pay off. For small ϵ we have

$$W\left((t_i^* - \epsilon) r_i^* K^w, r_i^* K^w + L_i^*\right) > W(t_i^* r_i^* g K^w, r_i^* g K^w + L_i^*)\ ,$$

[8] These assumptions could be motivated by infinitesimal relocation costs.

[9] We abstract from $\gamma = 1$ since this implies that the core resides in only one country in the North. The variable γ^* only describes off-equilibrium actions.

with $g \in \{\gamma^*, 1-\gamma^*\}$ .Thus, the reaction function can be described as

$$t_i^* = \begin{cases} t^j - \epsilon & \text{if } t_j^* > 0 \text{ , with } \epsilon \text{ arbitrarily small} \\ 0 & \text{if } t_j^* = 0. \end{cases}$$

From these findings we can conclude that – irrespective of the tax rates in the North – both Southern tax authorities will set their capital tax to zero in equilibrium.

The analysis for the Northern countries at stage 1 of the game is very similar. Since any economy is better off with some manufacturing, the Northern tax authorities will not set a tax that enables the South to steal the core. And because any marginal decrement against the other country's positive tax rate allows to improve welfare by attracting the full core rather than part of it, the equilibrium tax rates in the North are equal to zero as well. Thus, we can establish our Result 2.

Result 2. *Tax competition leads all countries to set their taxes to zero. Government welfare is lower than under autarky.*

The equilibrium described here would prevail under simultaneous tax setting of all four countries as well. This hinges on the fact that in contrast to Baldwin and Krugman (2004) capital and income are taxed independently. Therefore, the optimal capital tax rate in an economy without capital is zero. Intuitively, this makes the threat of stealing the core credible even in a simultaneous game.

4.3 Tax harmonisation

The zero-tax result established in the previous subsection pushes focus on the scope for tax harmonisation. There are several two-party coalitions one could think of. But it is straightforward to see that some coalitions cannot achieve anything. First, there is no scope for tax-harmonisation within the periphery. If taxes in the core remain zero, the periphery cannot attract the core, and nothing can be gained by coordinating tax setting.

Second, cross-regional cooperation is not useful either. This would imply that one of the core countries were to set a positive tax. But we know that this enables the other tax authority in the North to attract the full core. While this form of cooperation is merely useless for the periphery country it actually harms the involved Northern country.

The only promising coalition is one among the Northern countries. Let us assume that the Northern tax authorities both set their tax to some positive t^h.[10] We know from the analysis above that any tax $t^h > t^e$ would allow the South to steal the core and that this would decrease Northern welfare levels below those under tax competition. If tax rates are equal, the initial allocation of capital persists so that we can judge welfare in the Northern countries jointly. Consequently, the maximisation of joint government welfare boils down to

$$\max_{t^h} \quad W(t^h rK^w, (1-t^h)rK^w + L) \qquad (6)$$
$$s.t. \qquad 0 < t^h \leq t^e.$$

Recalling the definition in equation (5), we know that the optimal tax set in the North under tax harmonisation is $min\{t^a, t^e\}$. Furthermore, $W(t^h rK^w, (1-t^h)rK^w + L) > W(0, rK^w + L)$ so that government welfare with harmonised taxes is higher than under tax competition.

Result 3. *Under tax harmonisation Northern governments set their tax rates to* $t^h = min\{t^a, t^e\}$. *Government welfare in the North is higher under tax harmonisation than under tax competition.*

5 Conclusions

We have presented a model that explains the co-existence of agglomeration rents and a race to the bottom in capital tax rates. These two aspects have not yet been brought together in the tax competition literature. The reason for this result is that several tax authorities might reside in the agglomerated area and engage in harmful intra-regional tax competition.

We believe that this constellation – several jurisdictions competing for capital within one cluster of economic activity – is a reasonable picture of reality. On an aggregated level, countries in the centre of the European Union have an incentive to strategically set their tax rates lower than their neighbours in order to attract more of the manufacturing base. The same reasoning translates to the more disaggregated level of municipalities and counties if they can set capital taxes independently.

Allowing for intra-regional tax competition in a new economic geography framework brings us back to the neoclassical world where governments can improve their welfare by harmonising tax rates on mobile factors.

[10] Tax authorities always have an incentive to coordinate their tax rates since any discrepancy between tax rates would result in one country losing its share of the core which would reduce welfare.

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