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Agglomeration, Integration and Tax Harmonization

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Keywords: Economic Geography; Trade, Tax Competition, Tax Harmonization.

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1. Introduction

Does close economic integration, especially in the face of the growing mobility of capital both physical and human, require harmonization of tax rates? Many observers believe that it does. It is often argued that the nations of the European Union, in particular, must agree on common tax rates if they are to avoid a “race to the bottom” that will undermine their relatively generous welfare states. The logic seems straightforward: other things being equal, producers will move to whichever country has the lowest tax rates, and absent any coordination of tax-setting the attempt to attract or hold on to employment will lead to a competition that drives tax rates ever lower.

But things are not necessarily equal. Countries with generous welfare states tend to be countries that have long been wealthy; such nations offer capital the advantages of an established base of infrastructure, accumulated experience, etc. – in short, they offer favorable external economies. And within limits this presumably allows them to hold on to mobile factors of production even while levying higher tax rates than less advanced nations. On the other hand, should the tax rate get *too* high, the results could be catastrophic: not only will capital move abroad, but because that movement undermines agglomeration economies it may be irreversible.

What this suggests is that in the face of the sort of agglomerative forces emphasized by the “new economic geography”, the tax game played in the absence of harmonization may be something subtler than a simple race to the bottom. Advanced countries may be more like limit-pricing monopolists than Bertrand competitors; their interaction with less advanced countries need not lead to falling tax rates, and might well be consistent with the maintenance of large welfare states.

In any case, the purpose of this paper is to make an initial effort to think about international tax competition and goods market integration in the presence of significant agglomeration economies. The existing literature in this area is limited. Most of the vast tax-competition literature – see the survey by Wilson (1999) for instance – works with the ‘basic tax competition model’. This is a one-period model featuring a single good produced by two factors, labor, which is immobile between regions and capital, which is mobile. Trade costs are zero, firms face perfect competition and constant returns, so there is no trade among regions and capital faces smoothly diminishing returns. Typically, governments chose the capital tax rate (the labor tax rate is either ignored or assumed to be identical to capital's) in a Nash game. The standard approach is to compare equilibrium tax rates with no capital mobility and with perfect capital mobility; or to compare non-cooperative with cooperative tax setting both under prefect capital mobility. The customary result – equilibrium taxes are sub-optimally low – has been greatly extended and modified, but still remains the received wisdom on tax competition among social welfare maximizing governments. In one extension, where governments are assumed to deviate from social welfare maximization, tax competition may improve welfare by moving equilibrium rates closer to the social optimum in a typical second-best fashion. Two aspects of this literature are noteworthy. First, an analysis of tighter goods market integration and tax competition is absent since the focus is on heightened capital mobility. Second, although a small branch of this literature (e.g. Janeba 1998) does consider imperfectly competitive firms, the standard tax-competition literature entirely ignores issues of agglomeration externalities.

Three recent papers consider some aspects of the tax-competition and agglomeration nexus. Ludema and Wooton (1998) study the impact of 'globalization' on the intensity of tax competition in an economic geography setting where both factor-mobility cost and trade costs can be varied. They conclude that decreased trade costs may attenuate tax competition while easier factor mobility has mixed effects. These authors, together with Andersson and Forslid (1999), and Kind, Midelfart-Knarvik and Schjelderup (1998) make the important point that agglomeration creates rents for the mobile factor that can be taxed. This point also plays an important role in the analysis below.

The paper begins by briefly surveying some empirical trends in taxation within Europe. Then we turn to a simple, stylized model of economic geography in the face of taxes. In this subsequent section, this model serves as a basis for examining the game that uncoordinated tax authorities might play. The final section presents concluding remarks.

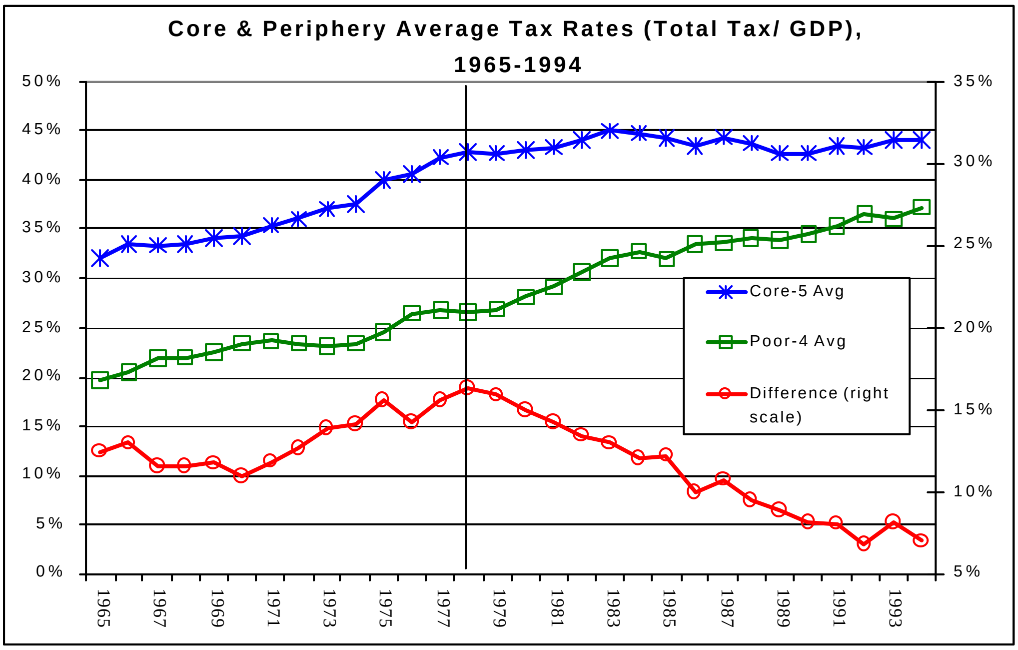
2. Taxation in Europe: Stylized facts

Increased economic integration is not a new development. Within Europe, in particular, barriers to trade both natural and artificial have been falling more or less continuously since the late 1940s. So it is possible, by looking at previous European experience, to get some idea of how increased integration and tax competition among nations have interacted in the past.

In making these comparisons we think of Europe as being divided into two parts: an advanced "core" that benefits from the agglomeration economies associated with being an established center, and a "periphery" that does not. And – with full knowledge of the crudeness of the approximation - we associate these two ideal types with specific countries: Germany, Benelux, France, Italy with the core, Greece, Portugal, Spain, Ireland with the periphery.

Figure 1 shows how the aggregate tax rate – that is, total tax revenue divided by GDP – has varied in the two regions since the mid-1960s. It is immediately apparent that there has not, at least so far, been anything that looks like a "race to the bottom". Over a period during which the integration of the European economy was steadily increasing, so was the average tax rate.

Figure 1

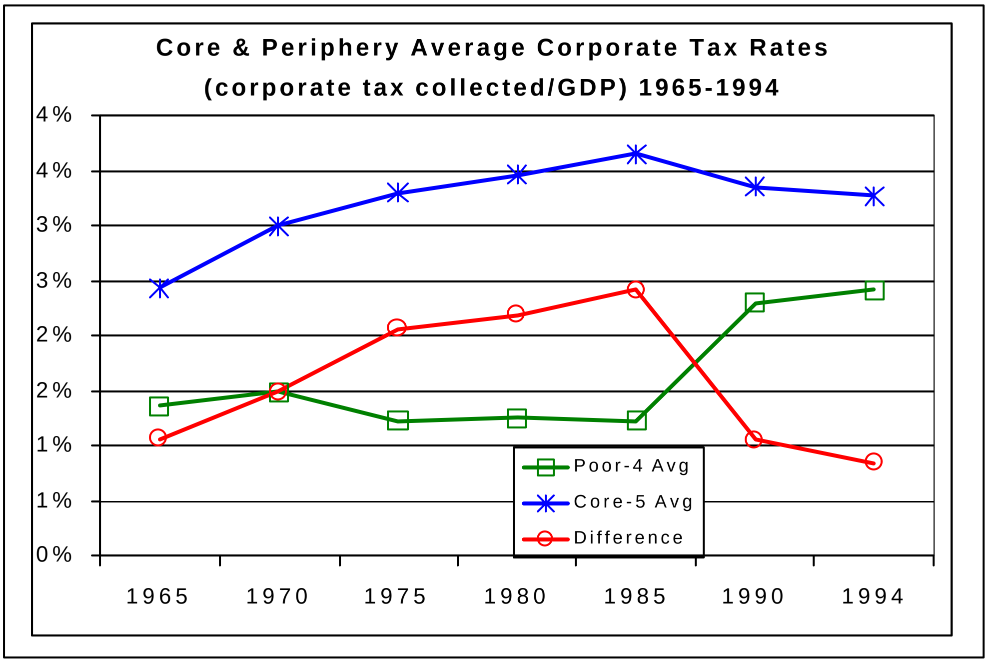


Notes: Core 5 = Germany, Benelux, France, and Italy. Poor-4 = Spain, Portugal, Ireland, Greece.
Source: OECD (1996) Table III.2 p. 75.

Even more surprisingly, it has by no means been uniformly the case that integration has led even to a narrowing of tax differentials. Tax rates have always been higher in the core than in the periphery; and the gap between them actually widened until the late 1970s, narrowing only more recently. Evidently the growing integration of Europe in the decades following the Treaty of Rome did not make core nations feel more constrained by tax competition from low-wage nations.

Only since 1978 have some faint signs of increased tax competition started to appear. In the 80s and 90s, the difference between core and periphery tax rates has narrowed importantly. However the nature of this narrowing is nothing like the race-to-the-bottom suggested by the standard tax-competition model. Indeed it seems more like a 'race to the top'; tax rates in the core nations leveled off while periphery rates converged upward (although one might wonder whether this is an effect of economic forces, or of the long-delayed emergence of democratic government in Southern Europe in the late 70s). And as indicated by Figure 2, corporate tax rates have started to decline in the core nations, although they have continued to rise in the periphery.

Figure 2



These trends certainly suggest that something more complex than the kind of tax competition that would produce a race to the bottom is going on. We turn next to a "new economic geography" model that may help make sense of the trends.

3. A model of tax competition with trade and factor mobility

We present the model of the underlying economy in which agglomeration forces are present before adding in tax competition game between governments. The model is a solvable variant of Krugman (1991) based on Forslid (1999).

3.1. Assumptions of the economic model

We consider a world with two countries (north and south), two factors of production (labor L and human capital K), and two sectors (industry X and agriculture Z). Countries are assumed to have identical preferences, technology and trade costs, but may have different L and K endowments as well as different tax rates. The X-sector (manufacturing) consists of differentiated goods and is modeled according to the Flam-Helpman version of the Dixit-Stiglitz monopolistic-competition model. Namely, manufacturing an X variety requires one unit of human capital (think of this as one "entrepreneur") plus a_x units of labor per unit of output. The cost function is thus $\pi+wa_x x_i$, where π is K's reward, w is L's wage rate, a_x is the unit input coefficient and x_i is output of variety i. K gets paid what the firm earns net of payments to labor due to K's variety-specificity, so K's reward is the operating profit of a typical variety.

The Walrasian (perfect competition and constant returns) Z-sector produces a homogenous good employing only L with a unit-input coefficient of a_x. By choice of units $a_z=1$ and a_x equals (1-1/ó).

We assume that both X and Z are traded; Z trade occurs costlessly, while X trade is impeded by frictional (i.e., 'iceberg') import barriers.[1] Specifically, $1+t \geq 1$ units of a manufactured variety must be shipped in order to sell one unit abroad; 't' is the barrier's tariff equivalent. Frictional barriers are meant to represent both explicit transport costs and so-called technical barriers to trade such as idiosyncratic industrial, safety, and health regulations and standards; they generate no rents or tax revenue.

Preferences of infinitely lived representative consumers (in both countries) are:

[1] We could relax this assumption by adopting a more involved Z sector, however the increase in complexity is not compensated by greater insight; see Davis (1998) and Fujita, Krugman and Venables (1999), Chapter 7.

$$U = C_{Xt}^{\mu} C_{Zt}^{1-\mu}\ , \quad C_X \equiv \left(\int_{i=0}^{K+K^*} c_i^{1-1/\sigma}\, di\right)^{\frac{1}{1-1/\sigma}}; \qquad 0 < \mu < 1 < \sigma \qquad \textbf{(1)}$$

where C_Z and C_X are the consumption of Z and of a CES consumption composite of manufactured goods, μ (a mnemonic for manufactures) is the Cobb-Douglas expenditure share on C_X, and σ is the elasticity of substitution among manufactured varieties. Also, c_i is consumption of variety i. Note that with full employment and one-unit of human capital per variety, the global number (mass) of varieties is K+K* ('*' denotes southern variables). There are two classes of consumers – K-owners and L-owners – but (1) gives the preferences for both. North's income and expenditure, E, equals wL+πK. South's, E*, equals w*L*+π*K*.

Labor is assumed immobile internationally. Human capital, K, by contrast moves freely in response to real wage differences. In particular, K moves from south to north whenever:

$$m = (\omega - \omega^*) s_K (1 - s_K); \quad \omega \equiv \frac{\pi\,(1-\tau)}{P}, \quad \omega^* \equiv \frac{\pi^*(1-\tau^*)}{P^*} \qquad \textbf{(2)}$$

where the ω's are the after-tax human capital real wages, and the π's and P's are, respectively, K's wages and the nation-specific perfect price indices that correspond to the preferences assumed in (1). The τ's are the tax rates. Notice that given preferences, the ω are also utility indices for K-owners. This *ad hoc* migration equation has the convenient property that migration stops when net real wages are equalized, or when all capital is in one region.[2]

3.2. Intermediate results

This formulation yields a number of familiar results. Utility optimization implies that a constant fraction μ of consumption expenditure E falls on X varieties with the rest spent on Z. It also yields a unitary elastic demand function for Z and standard CES demand functions for X varieties, namely:

[2] The migration equation can be more formally justified as stemming from optimizing behavior with quadratic adjustment costs and static expectations (Baldwin 1999).

$$c_j = \frac{s_j}{p_j}\mu E; \quad s_j = \left(\frac{p_j}{P_X}\right)^{1-\sigma}, \quad P_X = \left(\int_{i=0}^{K+K^*} p_i^{1-\sigma}\, di\right)^{1/(1-\sigma)} \qquad \textbf{(3)}$$

where s_j is variety j's share of total expenditure on X, and the p's and P_X are, respectively, consumer prices and the nation-specific perfect price index for all X-varieties. Observe that with $p_z=1$, the perfect price index corresponding to (1) is just $(P_X)^{\mu}$.

On the supply side, free trade in Z equalizes nominal wage rates as long as both countries produce some Z. This is always true as long as μ is not too large relative to the country-size difference.[3] For simplicity, this paper only considers values of μ that are low enough to ensure nominal wage equalization at all levels of trade barriers. Thus taking south L as numeraire, $p_Z=w=w^*=1$.

With monopolistic competition, optimizing X-firms engage in 'mill pricing'. North X-firms charge consumer prices 1 and 1+t in the north and south markets, respectively. South firms have isomorphic optimal pricing conditions. Recalling that there is one unit of K per variety, we rearrange a typical northern X-firm's first order condition to get the wage rate for northern human capital as:

$$\pi = \left(\frac{\mu}{\sigma}\right)\left(sE + s^*E^*\right) \qquad \textbf{(4)}$$

where s and s* are a typical north variety's share in the north and south markets; an analogous formula holds for π*. Using mill pricing in (3) and rearranging (4) into global quantities and national share variables, national operating profits (K wage rates) are:

$$\pi = B\left(\frac{\mu E^w}{\sigma K^w}\right); \qquad B \equiv \left(\frac{s_E}{s_K + \phi(1-s_K)} + \frac{\phi(1-s_E)}{\phi s_K + 1 - s_K}\right)$$

$$\pi^* = B^*\left(\frac{\mu E^w}{\sigma K^w}\right); \qquad B^* \equiv \left(\frac{\phi s_E}{s_K + \phi(1-s_K)} + \frac{1-s_E}{\phi s_K + 1 - s_K}\right) \qquad \textbf{(5)}$$

where E^w and K^w are world expenditure and world K stock, $s_K \equiv K/K^w$ and $s_E \equiv E/E^w$ are north shares of K^w and E^w. Note that our X-sector technology implies that north's share

[3] When μ violates this, all world Z can be produced in the south, so while $p_Z=p_Z^*=1$, free trade in Z no longer equalises w's, in fact due to agglomeration forces, $w>w^*=1$.

of world industry exactly equals its share of world capital. Also, $\phi\equiv(1+t)^{1-ó}$ measures trade openness (ϕ is a mnemonic for the 'free-ness', or phi-ness, of trade, with trade getting freer as ϕ rises from $\phi=0$ with prohibitive trade barriers, to $\phi=1$ with free trade). Here B and B* are mnemonics for the 'biases' in national sales; e.g. B measures the extent to which a north variety's sales exceed the world average of per-variety sales (which is $\mu E^w/K^w$).

Note that world expenditure, defined as $wL^w+\pi K^w$, simplifies to $L^w/(1-\mu/\sigma)$ given $w=w^*=1$ and (5). With this, the equilibrium s_E can be written as:

$$s_E = \frac{[1-(1-b)(1-f)s_K]s_L + bfs_K}{f-(1-f)[b(1+f)+1-f]s_K(1-s_K)}\left(f+(1-f)s_K\right); \quad b\equiv m/s \qquad \textbf{(6)}$$

This is unambiguously increasing in s_K and north's share of world L, i.e. $s_L \equiv L/L^w$.

This model displays the backward and forward linkages that are the hallmark of “new economic geography” models. The backward (demand) linkage can be seen from (6) by noting that an increase in north's share of world industry, namely s_K, increases north's share world expenditure, s_E, and, given (5), this makes location in the north more attractive by boosting the northern reward to K. The forward linkage concerns the impact of increasing north share of industry on the cost-of-living in the north. From the definition of P_X, an increase is s_K raises K's real wage in the north and thereby makes north a more attractive location for K. The dispersion force, often called the local-competition effect, stems from the way in which an increase in s_K (holding s_E constant) harms K's wage in the north by lowering B in (5).

In the tax game below we focus on the situation where the core is already agglomerated in the north. Due to backward and forward linkages, this implies that K’s reward includes an agglomeration rent, so K’s reward in the north, π/P, is higher than its reward in the south, π^*/P^*. This agglomeration rent makes K, which can re-locate costlessly in our model, into a quasi-fixed factor that can in principle be taxed without effect on northern firms’ location decisions. To measure the agglomeration rent, it proves convenient to examine the ratio, rather than the difference, between the real rewards to K and K*. This is (using $s_K=1$ in (5) and the definition of the price indices):

$$\Psi \equiv \frac{p/P}{p^*/P^*} = \frac{1}{1-(1-\phi)^2[s_L+(1-s_L)b]}\,\phi^{1-\frac{\mu}{\sigma-1}}; \quad b \equiv \mu/\sigma < 1 \qquad \textbf{(7)}$$

Observe that the agglomeration rent is increasing in the intrinsic national size difference s_L, and in the strength of agglomeration forces as measured by μ and $1/\sigma$.

Importantly, the impact of trade free-ness on Ψ is bell-shaped. Starting from low levels of trade free-ness ϕ (i.e. high trade costs) tighter integration increases the agglomeration rent, but beyond a certain ϕ, further integration lowers agglomeration rents. Consequently, the agglomeration rents will be largest when the core region is much larger than the periphery region and when trade costs are at an intermediate level.

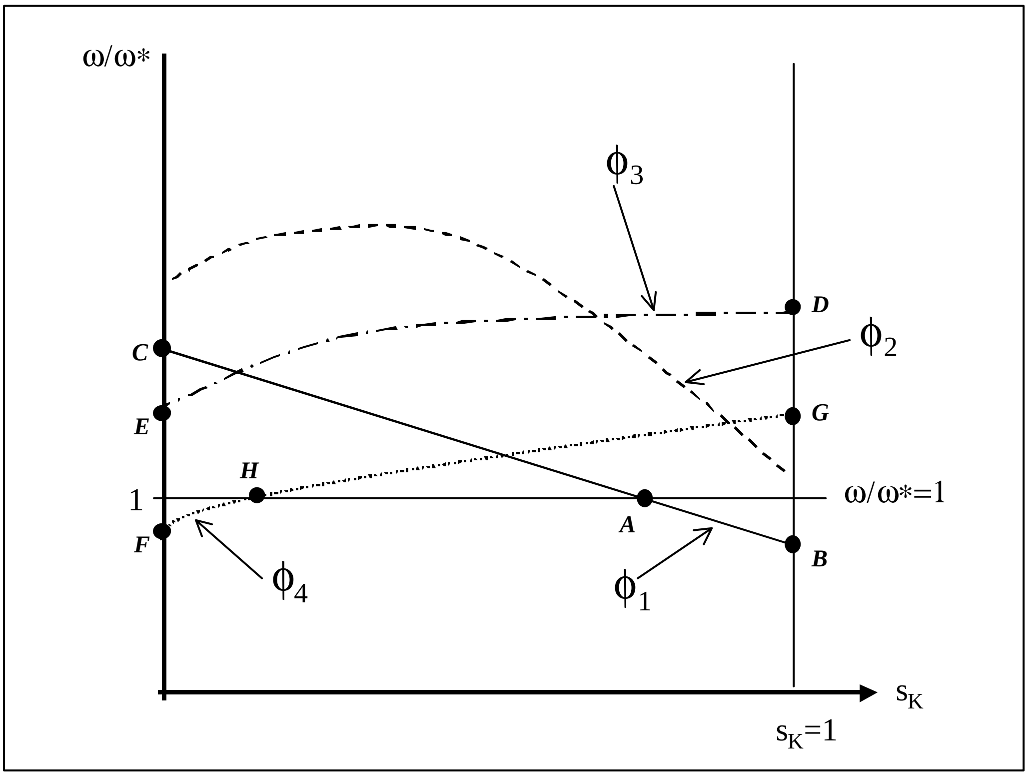
3.3. The no-tax case

As a guide to intuition, we first solve the model for the case where both national tax rates are zero. An important feature of Europe's economic geography is the asymmetric size of the 'core' nations and the 'periphery' nations. The core-5 from Figure 1 has a total population of about 225 million while the periphery-4 have only 63 million. Consequently, we work with the case of asymmetric-sized nations.[4]

In finding equilibria, the key variable is the international division of the mobile factor K, and our search is facilitated by inspection of the migration equation (2). That equation shows that there are three types of potential long-run equilibria, i.e. levels of s_K where K migration, m, equals zero. These are the two core-periphery outcomes (since m=0 when s_K equals 1 or 0) and interior outcomes (since m=0 despite $0<s_K<1$, when real rewards are equalized, i.e. $\omega=\omega^*$). The level of trade free-ness affects which and how many of these equilibria exist; ϕ also alters the stability of the equilibria. Figure 3 shows the various possibilities by illustrating how the real wage ratio for K, namely ω/ω^*, varies with s_K for four different levels of trade free-ness, ϕ. Although some aspects of the diagram can be established analytically, it is more straightforward to show the ω/ω^* curve for specific parameter values. Here we take central parameter values used throughout the paper, namely $s_L=2/3$, $\mu=4/10$ and $\sigma=2.5$.

[4] The solution of this sort of economic geography model under symmetry is well known (see Krugman 1991, or Fujita, Krugman and Venables 1999).

Figure 3: The 'Wiggle' Diagram with Asymmetric Nations and No Taxes

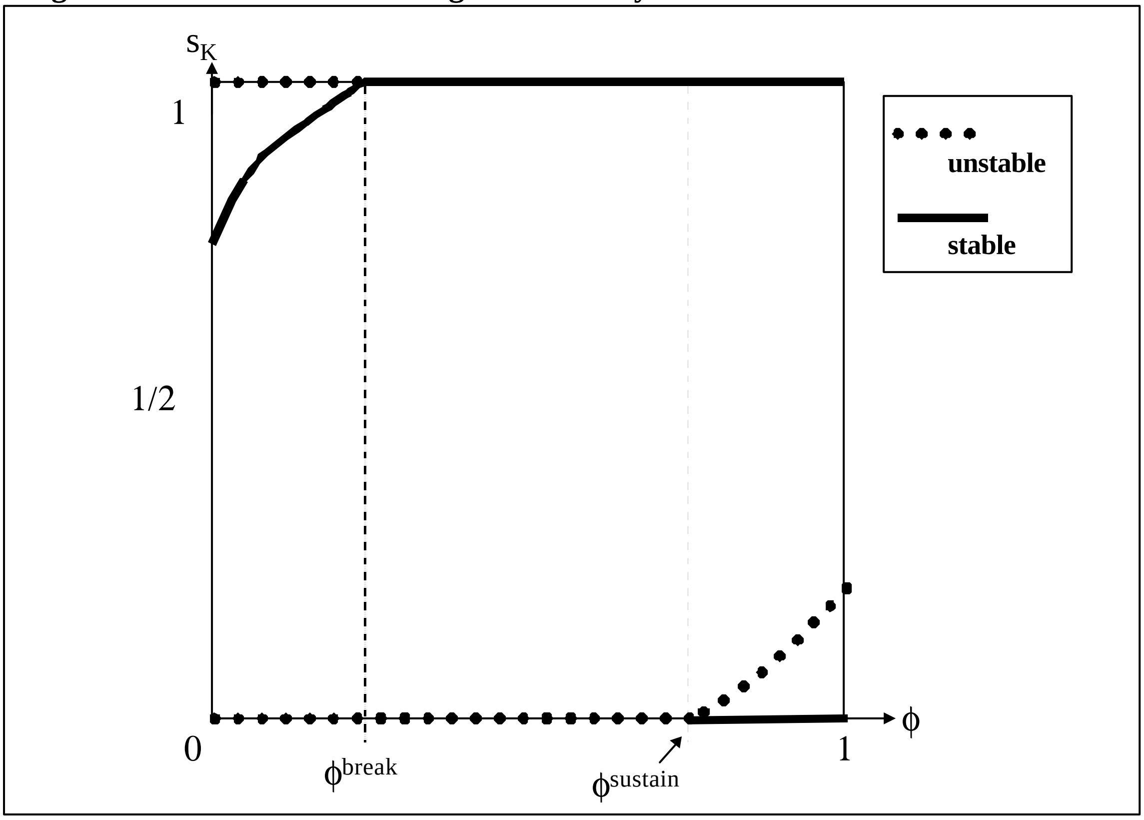


When ϕ is very low, say ϕ_1, the wage ratio falls as north's share of K rises. In this case, all three types of equilibria exist, with the interior equilibrium occurring at a level of s_K indicated by the point A. The interior equilibrium is stable in the sense that a slight perturbation of s_K would be self correcting. For example, an slight increase of s_K from A would yield a wage ratio below unity and this would lead K to move back towards point A. The two core-periphery outcomes, by contrast, are unstable. At point C, the wage ratio, ω/ω^*, exceeds unity so a slight perturbation would lead to south-to-north K migration, and at point B, the opposite holds. As trade gets freer, the ω/ω^* curve shifts up and rotates counterclockwise. At a somewhat higher level of ϕ, say ϕ_2, the ω/ω^* curve lies entirely above the unity line. For such ϕ's there is no interior equilibrium. Migration only stops when s_K=1 or s_K=0, with only the former being stable.

As trade free-ness rises further, the ω/ω^* curve continues to rotate counterclockwise and at some point, ϕ_3 in the diagram, the ω/ω^* curve is entirely above the ω/ω^*=1 line <u>and</u> has a positive slope everywhere. This situation is not of much interest for now, but it will play an important role in the tax game to be introduced below. Finally, at a sufficiently high level of trade free-ness, the ω/ω^* curve is positively sloped and it crosses the ω/ω*=1 line. Here again we have three equilibria marked F, H and G in the diagram. F and G are stable while H is unstable.

This same set of outcomes can be illustrated with what is called the 'tomahawk' diagram in the economic geography literature (see Figure 4). The heavy solid lines in the diagram show the stable equilibria while the dotted lines show the unstable equilibria. The level of ϕ where the stable interior equilibrium just disappears is marked as ϕ^{break} and the level where the unstable interior equilibrium comes into existence is marked as $\phi^{sustain}$.

Figure 4: The 'Tomahawk' Diagram with Asymmetric Nations and No Taxes



3.4. The tax game

We now turn to the analysis of tax competition, focusing on the case where industrial activity is already agglomerated in the north. In our simple model this means that south literally has no industry and s_K=1.

Taxes are collected from both factors of production; we assume that the tax on K and L must be identical, for political reasons (taken as exogenous to the model). The reason for this assumption should be obvious: if mobile and immobile factors could easily be taxed at different rates, countries could concentrate their taxation on the immobile factors, and the debate over tax harmonization would be much less intense.

To focus on essentials, we work with a simple, reduced-form government objective that is meant to capture the trade off governments face between their desire to raise tax revenue and their desire to limit tax-induced inefficiencies. The reduced-form government's objective function for the north is:

$$G = f\left(\frac{E/N}{P}\right)R - t^{2}/2\,; \qquad R \equiv t\,(wL + pK), \quad f' > 0 \tag{8}$$

where (E/N)/P is real per-capita expenditure, N is the northern population (L plus K), and R is tax revenue. Note that with f'(·)>0, governments' marginal benefit from tax revenue is increasing in real per-capita income. This means that, other things equal, richer societies tend to prefer higher levels of taxation and government spending – a commonly observed fact (Boix 1999). The second term in the objective function, $\tau^2/2$ is a simple means of capturing the rising distortionary impact of taxation. To avoid unenlightening complications, tax revenue is returned in a lump sum fashion to consumers. The southern government has an isomorphic objective function.

We work with a three-stage tax game where north (the nation that initially has the core) sets its tax rate τ in the first stage, south sets its rate in the second stage, and migration and production occur in the third stage. Clearly this structure maximizes the ability of the south to engage in fiscal competition. The last stage yields an economic outcome that is described by the equilibrium conditions laid out above, so we turn to the second stage.

In solving the second stage, it is important to note that the southern objective function is discontinuous. If the south chooses a sufficiently high tax rate, no industry/entrepreneurs will move from north to south; southern tax revenue is then just $\tau^*w^*L^*$. If, however, south chooses a tax rate low enough to attract all industry, i.e. to capture the core, it has a higher tax base and thus higher revenue for any given tax rate. The first task is thus to find the southern tax rate that would induce northern firms to delocate to the south. This is called τ^*_{deloc} and it is defined as the southern tax rate that would make a northern firm just indifferent between the north and south when all other industry is in the north. Thus:

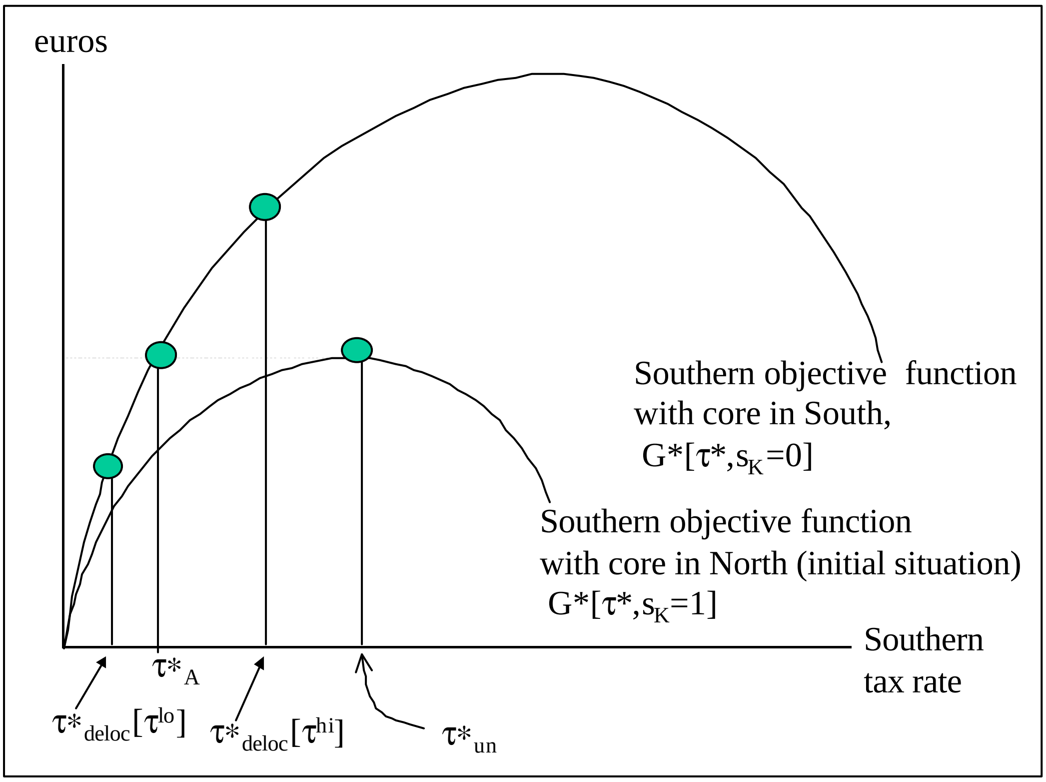
$$(1-t^*_{deloc}) = (1-t)\Psi \qquad \textbf{(9)}$$

where Ψ is the agglomeration rent from (7). Three aspects of τ^*_{deloc} are important in the analysis that follows. τ^*_{deloc} falls with the strength of agglomeration forces as measured by μ and $1/\sigma$ since Ψ rises with μ and $1/\sigma$. The 'core stealing' level, τ^*_{deloc}, rises with τ, and lastly, τ^*_{deloc}, like Ψ, is bell-shaped with respect to the free-ness of trade.

The idea behind (9) is that if any firm wished to migrate southward, all would. For this to be correct, however, we need to rule out the possibility that there is some stable interior equilibrium at an intermediate s_K where the tax rate gap is just offset by the international gap in K's real wage. A sufficient condition for this is that the ω/ω^* curve is everywhere positively sloped with respect to s_K; in this case, the value of moving to the south increases with north-to-south K migration. As Figure 3 showed, a positive slope is attained when trade is sufficiently free. Under our central parameter case, ω/ω^* evaluated at s_K=1 curve is upward sloping for all ϕ above 0.41. For the rest of the paper, we restrict ourselves to levels of ϕ that meet this condition. Since ϕ=0.41 corresponds to a tariff equivalent of trade costs of about 80%, this assumption is not very restrictive.

Figure 5 illustrates the discontinuous problem facing southern tax setters in the second stage. The vertical axis shows the metric for the government's objective function (euros) and the horizontal axis plots the southern tax rate τ^*. The top bell-shaped curve is the southern objective function when the core has delocated to the south. It is bell shaped because revenue collected rises linearly with the tax rate but the inefficiency effect – minus $\tau^{*2}/2$ – grows with the square of the rate. The lower bell-shaped curve, which applies when $\tau^*>\tau^*_{deloc}$, is the southern objective function when the core remains in the north.

Figure 5: Stage Two of the Tax Game – South's Choice



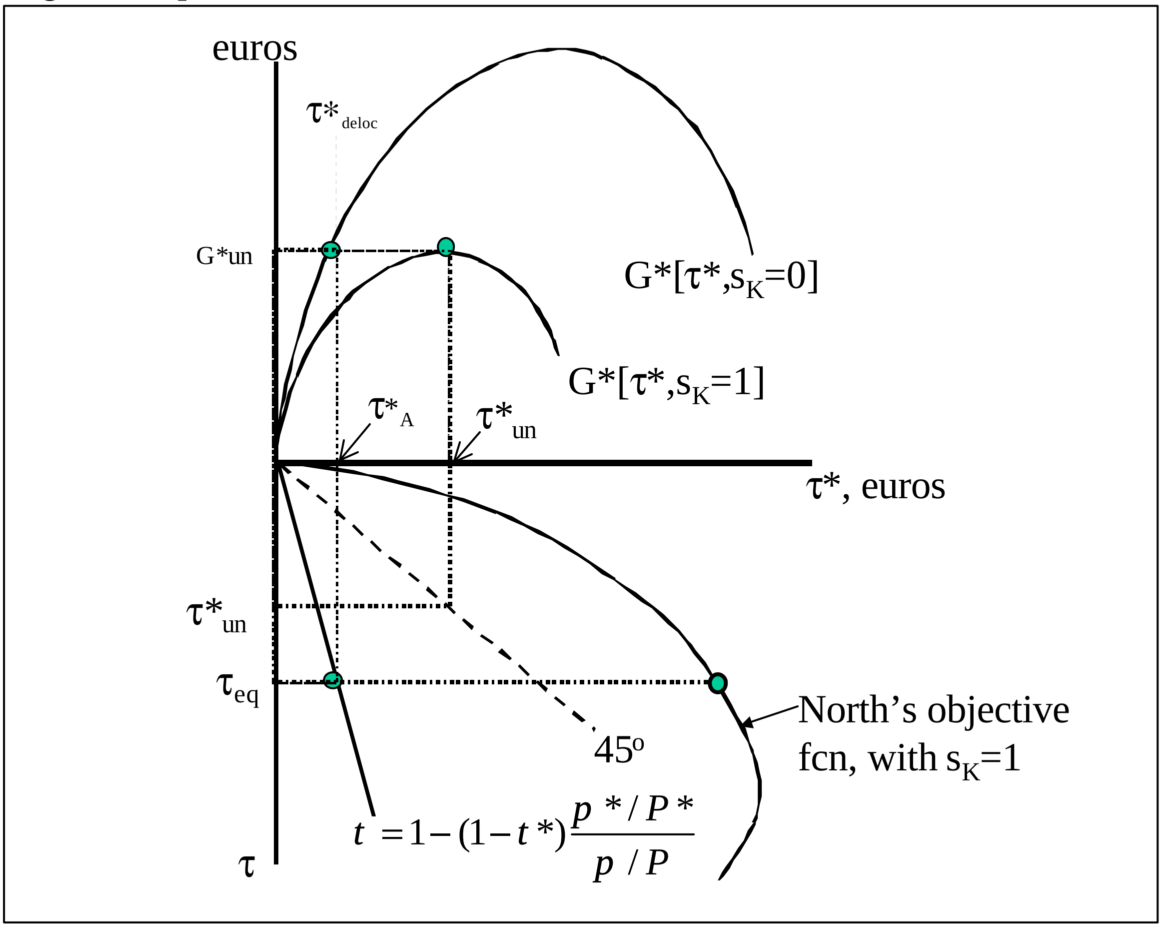
To find the optimal southern tax rate given τ, we compare the optimal τ^*'s from the core-stays-north case and the core-goes-south case. In the first case, the southern government is unconstrained by its desire to have the core, so it chooses τ^* equal to τ^*_{un} as shown in the diagram. The formula for τ^*_{un} – derived from maximization of the south's version of (8) – is:

$$t^*_{un} = (1 - s_L)(K^w f)^{-2m/(s-1)} \tag{10}$$

Plainly, this is increasing in the free-ness of trade and the strength of agglomeration forces, μ and $1/\sigma$. In the alternative core-goes-south case, the southern government's objective function is the upper bell-shaped curve in Figure 5, and here τ^* is constrained to be no higher than τ^*_{deloc} (to ensure the core moves south). As (9) shows, the precise level of τ^*_{deloc} depends upon the level of τ set by the northern government in the first stage. Figure 5 shows two possibilities. When north chooses a high τ, τ^*_{deloc} is also high, for example at the level marked as $\tau^*_{deloc}[\tau^{hi}]$. When north chooses a low τ, τ^*_{deloc} is also low, for example at $\tau^*_{deloc}[\tau^{lo}]$.

As drawn, the southern government would lower τ^* to τ^*_{deloc} – and thus steal the core – if the northern government had chosen τ^{hi}. However, if the northern government had set its rate at τ^{lo}, south would find it optimal to allow the core to remain in the north, choosing τ^*_{un} instead of $\tau^*_{deloc}[\tau^{lo}]$. In short, moving to the higher schedule would be worth paying the price of a constrained tax rate when τ is at τ^{hi}, but not when it is at τ^{lo}.

Figure 6: Equilibrium Tax Rates.



Of course in stage-one, the north is aware of its influence over the south's decision. The lower is the τ chosen, the lower will be τ^*_{deloc} and thus the less attractive will be the core-stealing option to south's government. In the first stage north will presumably want to set its rate such that south will *not* find it worthwhile to "snatch" the core. What north has to do, then, is to push its tax rate low enough that south is indifferent between its unconstrained optimum without the core and its constrained optimum with it – a situation illustrated in Figure 6. The top panel of the diagram reproduces the stage 2 game for south. Mechanically, the equilibrium northern rate – call this τ_{eq} – is calculated by first finding τ^*_{un} and its corresponding objective function level, marked G^*_{un} in Figure 6. Using this, we find the level of τ^* (call this level τ^*_A) that satisfies $G^*_{un}=G^*[\tau^*_A,s_K=0]$. Finally we find τ_{eq} as the solution to (9) when $\tau^*_{deloc}=\tau^*_A$. Plainly this "limit tax" game is akin to the equilibrium of a Stackleberg game where the leader "limit prices" a potential entrant.

The last step is to check that north actually prefers this limit tax rate to the rate it would have if it surrendered the core. At least when $s_L=1/2$, this is easy. In this case, the 'with-core' and 'without-core' G's for north are the same as those for south. Since $\tau_{eq}>\tau^*_{deloc}$, we see that north has a higher G at τ_{eq} than south does with τ^*_{deloc} (or τ^*_{un}). In other cases we rely on numerical calculation to verify that north actually does wish to "limit tax" the south.

To summarize the outcome of this tax game, note that the equilibrium southern rate, τ^*_{un}, is given by (10). We also have an analytic expression for the north tax rate, τ_{eq}, but it is too unwieldy to be revealing.[5] Thus we turn to numerical examples.

3.5. Numerical Analysis

The first step is to calibrate the parameters in the model to reproduce the stylized facts discussed above. We want the core's equilibrium tax rate to exceed the south's, and we want the gap to first widen and then narrow as the level of trade free-ness, rises, with much of the gap narrowing coming from rising south rates. The principle parameters to be chosen are the share of labor in the north (namely s_L), the world wide number of firms K^w (this affects the equilibrium wage of K and thus the extent to which production shifting affects market sizes), the X-sector expenditure share μ and the Dixit-Stiglitz elasticity σ. After some experimentation, our central case assumes $s_L=2/3$, which is about the core-5's (Germany, France, Benelux and Italy) share of EU population, $K^w=1/6$ (which yields a nominal reward to human capital that is 15% higher than labor's wage rate), $\mu=4/10$ and $\sigma=2.5$.

[5] The analytic solution and derivations of (6), (7), and (10) can be found in the MAPLE worksheet BKtax.mws, available from the authors or on http://wwwhei.unige.ch/~baldwin/ (posted September 2000).

Figure 7: Simulated Tax Rates with Increased Trade Integration.

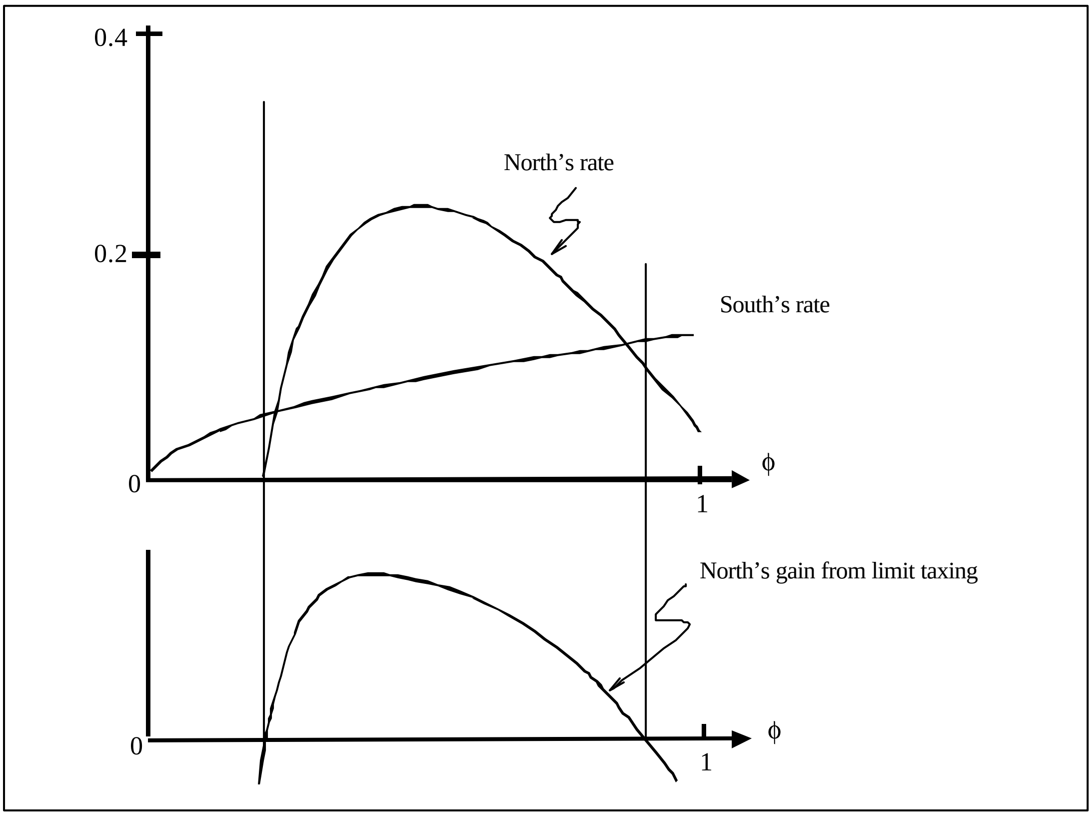


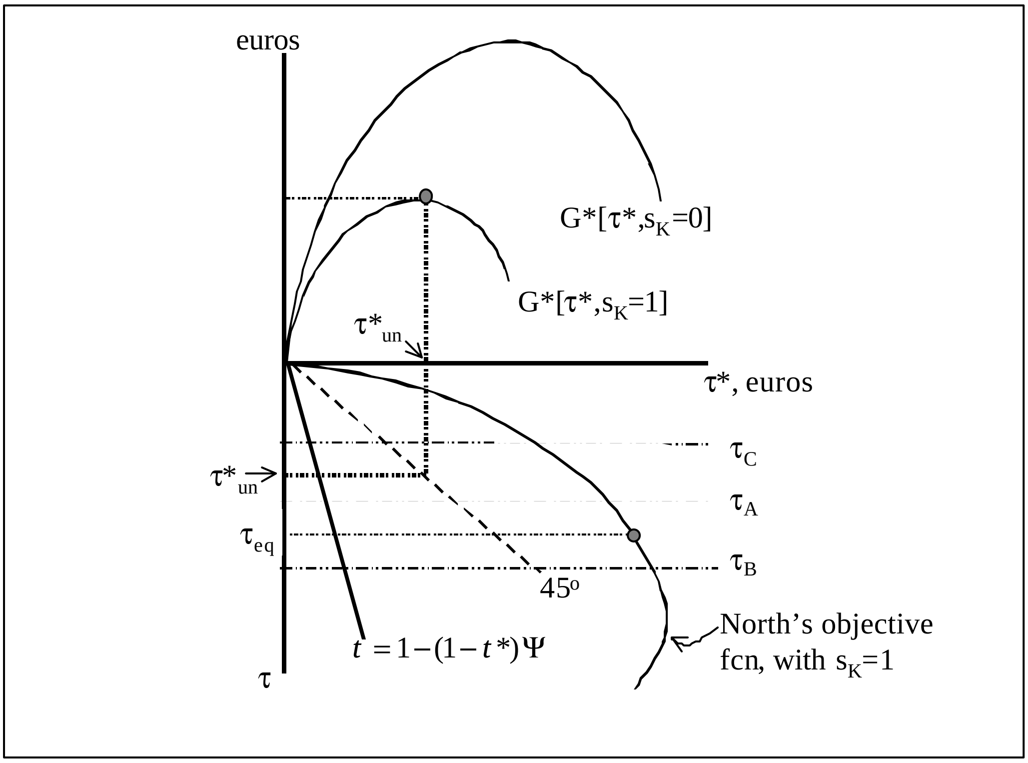
Figure 7 illustrates the central parameter case. The top panel shows the equilibrium tax rates in the limit taxing game for various values of trade free-ness, ϕ. To check whether the north would actually prefer to keep the core by limit taxing, the bottom panel plots the difference in the value of the north's objective function under two alternatives. The first is when it keeps the core and limit taxes. The second is when it allows the core to delocate to the south and sets its tax rate without regard to tax competition. The bottom panel reveals that at very high levels of trade free-ness, the north would not benefit from limit taxing. However, as comparison of the two panels shows, north prefers to limit tax in the range of ϕ's where the northern tax rate exceeds that of the south. We focus on this range for two reasons. First, this is the situation observed at least since 1960 in Europe. Second, this range corresponds to reasonable trade costs (recall that these include all manner of costs of selling abroad, not just transport costs). In particular under the central-case parameters, north charges a higher tax when the tariff equivalent of trade costs is at least 10.2%.

4. Tax Harmonization

This setup suggests that tax harmonization has somewhat unexpected results. In the basic tax competition model, tax harmonization basically entails a shift from a non-cooperative tax game to a cooperative tax game. As a result, harmonization leads to a Pareto improvement from the government's perspective almost by definition.[6]

Consider first the most straightforward tax harmonization scheme, i.e. adoption of a common rate that lies between the two initial rates, τ_{eq} and τ^*_{un}. As it turns out, this split-the-difference harmonization makes both North and South worse off as Figure 8 shows. First, note that this single rate, τ_A in the diagram, would not lead to a shift in the core from north to south since with equal taxes, firms prefer to stay agglomerated in the north. Given that the south remains without industry, south's loss follows directly from the fact that its pre-harmonization rate was an unconstrained maximum. The loss for north is similarly clear. Compared to the initial equilibrium, the harmonization forces the north to lower its tax rate, when in fact that north would have preferred to raise it.

Figure 8: Tax Harmonization Schemes



[6] In models where government are not social welfare maximizers, so-called Leviathan models, harmonization may make governments better off but lower welfare in both nations.

A second possible candidate for the single-rate harmonization would entail a rise in both nations' rates to something like τ_B in the diagram. Here north would gain (since its tax-competition constraint would be relaxed) but south would lose for the reasons just mentioned; any change in the equilibrium southern rate lowers the south's welfare as measured by its government's objective function. A lowering of both rates to something like τ_C would also make both governments worse off.

It is easy to understand why there is no single rate that nations could agree upon in our model. In a lumpy world with industry already agglomerated, tax competition is a rather one-sided affair. The tax rate of the nation with the industry is constrained by competition. The tax rate of the periphery nation is not. Consequently, there is no mutual gain to cooperation.

While the most straightforward tax harmonization scheme would never be agreed to, there is a simple proposal that would be weakly Pareto improving from the government's perspectives, namely a simple tax floor set just below at the equilibrium tax rate of the low-tax nation. Again the logic is straightforward. To dissuade the south from "stealing" the core in the limit tax game, the north must ensure that even if the south did get the core, it would be no better off than if it did not have the core. This, in turn, requires the north to base its rate on the off-equilibrium southern tax τ^*_{deloc}. And this despite the fact that south ends up charging the higher rate τ^*_{un} in equilibrium. By setting the minimum just below the south's equilibrium rate, the minimum tax scheme rules out the off-equilibrium τ^*_{deloc} by fiat. Given this, the north can now base its rate on the higher equilibrium southern rate τ^*_{un}. This effectively relaxes a binding constraint on north's choice, so the tax-floor-scheme raises the level of north's objective function. The scheme has, by construction, no impact on south's situation.

5. Concluding Remarks

This paper makes an initial effort to think about international tax harmonization and goods market integration in the presence of significant agglomeration economies. The presence of agglomeration forces makes the economy "lumpy" in the sense that industry tends to stay together, either all in one region or all in the other. The lumpiness also gives industrialized nations – the so-called core nations – an advantage over the less industrialized nations – the so-called periphery. Due to agglomeration-linked external economies, industry is not indifferent to location in equilibrium; tax issues apart, each industrial firm understands that it earns more in the core than it would in the periphery. Knowing this, core governments can tax their industry at a higher rate than the periphery, as long as the rate is not too much higher. Indeed, we can think of the core government as engaging in a "limit tax" game in which it sets a tax rate sufficiently low to make the periphery government abandon the idea of trying to attract the core. Moreover, given that the core government will not let industry go, the periphery government can choose its rate unconstrained by considerations of attracting industry. The result of this is that tax competition is a rather one-sided affair. The core finds its tax rate constrained by potential competition from the periphery, but since the core limit taxes, the south knows it will not get the core and so sets its tax rate on purely domestic concerns.

In this sort of setup, it turns out that increased integration – defined by lower trade costs – has very non-monotonic effects on the equilibrium core-periphery tax gap. As is well known from the economic geography literature, agglomeration forces are strongest for intermediate trade cost, i.e., when trade costs are low enough to make agglomeration possible yet high enough to make it worthwhile. Due to this bell-shaped link between trade costs and agglomeration, integration naturally leads to a bell-shaped core-periphery tax gap in our limit-taxing game. Interestingly, average tax rates in Europe do seem to have followed such a pattern. In the 1950s, 1960s and 1970s, European integration proceeded at a very rapid pace, yet the industrialized core nations (Germany, Benelux, France and Italy) raised taxes more rapidly than did the less industrialized periphery nations (Spain, Portugal, Ireland and Greece). Integration has continued in the 1980s but during this integration phase, tax gaps narrowed, but much of the gap narrowing came from rising periphery rates. This was not a simple case of core nations having to cut their rates to match those of the periphery, as suggested by traditional analysis.

The limit-taxing feature of a model with agglomeration forces also has important implications for tax harmonization. The traditional analysis, based on Nash tax competition, views tax harmonization as a shift from a non-cooperative outcome to a cooperative one; harmonization is thus likely to improve the lot of all nations (or at least their governments). In our model, simple tax harmonization – defined as adoption of a common tax rate – always harms at least one nation and the seemingly sensible policy of adopting a rate that is between the two initial rates turns out to harm both nations. Interestingly, a tax floor, even when it is set at the lowest equilibrium tax rate, leads to weak Pareto improvement, with the high-tax nations gaining and low-tax nations left unchanged.

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