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AGGLOMERATION, INTEGRATION AND TAX HARMONIZATION

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ABSTRACT

We show that agglomeration forces can reverse standard international-tax-competition results. Closer integration may result first in a 'race to the top' and then a race to the bottom, a result that is consistent with recent empirical work showing that the tax gap between rich and poor nations follows a bell-shaped path (Devereux, Griffith and Klemm 2002). Moreover, split-the-difference tax harmonization can make both nations worse off. This may help explain why tax harmonisation – which is Pareto improving in the standard model – is so difficult in the real world. The key theoretical insight is that agglomeration forces create quasi-rents that can be taxed without inducing delocation. This suggests that the tax game is something subtler than a race to the bottom. Advanced 'core' nations may act like limit-pricing monopolists toward less advanced 'periphery' countries. Since agglomeration rents are a bell-shaped function of the level of integration, the equilibrium tax gap in our tax game is also bell shaped.

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Agglomeration, Integration and Tax Harmonisation

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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 harmonisation 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 favourable 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 harmonisation 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.

The purpose of this paper is to think about international tax competition and harmonisation in the presence of significant agglomeration economies and goods market integration. 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

[1] Forthcoming in the European Economic Review. This paper was written while Baldwin was visiting MIT in 1998/1999, with the first draft in December 1998 and revisions in June 2000 and April 2002. We thank the editor and two anonymous referees for excellent input, and Federica Sbergami and Tommaso Mancini for excellent assistance.

competition model' (BTCM). This is a one-period model featuring a single good produced by two factors; labour, 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 labour 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 maximisation, 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.

Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) review the tax and agglomeration literature that has emerge since the 1998 draft of our paper in detail, but three papers are particularly noteworthy. The first paper in this area is Ludema and Wooton (1998). This paper studies the impact of varying both factor-mobility costs and trade costs and seems to find that lowering either cost may – in contrast to the standard BTCM result – result in higher taxes being chosen in a tax competition game among governments. 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. Our paper focuses solely on the case where industry is fully agglomerated in one region and we find that the tax gap between nations is bell-shaped in trade openness – first rising and then falling as trade gets more open. Most importantly, we explicitly consider the implications of agglomeration forces for tax harmonisation schemes.

The paper begins by briefly surveying the standard tax-competition literature's main results. Then we present some empirical trends in taxation within Europe. Next we turn to a simple, stylised model of economic geography in the face of taxes. We note that our main results turn on properties that hold in a wide range of economic geography models, so we conjecture that our results would hold in many models, but to be specific, we work with a model that is simple enough to allow us to obtain analytic results.[2] In this subsequent section, our specific model serves as a basis for examining the game that uncoordinated tax authorities might play. The final section presents concluding remarks.

[2] See Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) for details of this argument.

2. STANDARD TAX COMPETITION RESULTS

We briefly discuss the main tax competition results and their logic to boost intuition for why the inclusion of agglomeration forces leads to such different results.

The Basic Tax Competition Model

As Wilson (1999) writes: "A central message of the tax competition literature is that independent governments engage in wasteful competition for scare capital through reduction in tax rates and public expenditure levels." The literature focuses on the 'basic tax competition model' typically ascribed to Zodrow and Mierzkowski (1986).

Our rendition of the 'standard tax competition model' (BTCM for short) involves two nations, which we call north and south, and two factors of production, capital and labour. The two economies are perfectly competitive, they produce a single private good under constant returns and they trade this good costlessly. Trade equalises international prices but not factor prices since there are more factors than goods. For convenience the good's price is normalised to unity everywhere. Labourers are completely immobile internationally. The world capital stock K^w is fixed and capital is either perfectly mobile across nations, or perfectly immobile. Home technology is given by:

(1) $$Y = F[K, L]; \qquad F_L, F_K > 0 > F_{KK}$$

where L and K are the amounts of capital and labour employed, F_L, F_K and F_{KK} are the first and second partial derivatives of the production function in the usual notation. The representative consumer is a labourer who owns all the economy's factors and has convex preferences given by:

(2) $$U = U[G, C]$$

where G is a public good (provided only by government) and C is private consumption.

As far as the tax structure goes, we assume that the same tax rate is applied to all factor income generated inside the nations (source principle). We choose units of G such that the cost of G in terms of C is unity, so the supply of G just equals tax revenue.[3] The south has isomorphic tastes, technology and tax structure.

It is critically important to distinguish between the amount of capital employed in the north and the amount of capital north owns, so we use 'n' to indicate the former and K to indicate the latter. Without loss of generality we normalise the world's fixed capital stock, K^w, to unity, so $n+n^*=K^w=1$, where n^* is the amount of capital working in the south. The spatial allocation of capital is determined by the equalisation of post-tax rates of return, when capital is perfectly mobile. When capital is immobile, endowments define the allocation. Factors are paid their marginal products so the location condition is:

[3] Taxes are collected in terms of Y, so the assumed production function for G is G=tY, or alternatively, G=F[K,L] where K and L are hired by the government using the collected Y.

$$\textbf{(3)}\qquad \begin{array}{ll} F_K[n,L](1-t) = F_K[1-n,L^*](1-t^*), & \textit{with K mobile} \\ n = K, \quad n^* = K^*, & \textit{with K immobile} \end{array}$$

where *t*, *L* and *K* are home's tax rate, labour force and capital endowment, while *t**, *L** and *K** are the corresponding southern variables.

The two governments maximise the utility of their representative consumer. For example, the north's objective function is:

$$\textbf{(4)}\qquad \max_t U[G,C]; \qquad C = (1-t)I, \quad G = tY, \quad Y = F, \quad I = F - F_K n + F_K K$$

Here *Y=F[n,L]* is northern GDP, and *I* is northern GNP since factors are paid their marginal return and $LF_L=F-F_Kn$ given constant returns. The south has an isomorphic objective function. The two governments play Nash in tax rates and the north's first order condition is:

$$\textbf{(5)}\qquad \frac{U_G}{U_C} = \frac{-dC/dt}{dG/dt}; \qquad \frac{-dC/dt}{dG/dt} = \frac{I}{Y(1+\frac{dn/n}{dt}\eta t)}; \qquad \eta \equiv \frac{n\partial F}{Y\partial K}$$

where the left-hand side is the net marginal social benefit of more tax revenue; given standard concavity assumption on preferences, this falls as the tax rate rises. On the right-hand side (RHS), $\eta>0$ is the capital-output elasticity and dn/dt is the responsiveness of capital to northern taxes, taking the southern tax rate as given.[4] Totally differentiating (3), we have:

$$\textbf{(6)}\qquad \frac{dn/n}{dt} = \frac{F_K/n}{(1-t)F_{KK} + (1-t^*)F^*_{KK}}$$

where F_{KK} and F^*_{KK} indicate the second partial of F with respect to K evaluated at, respectively, the north's and the south's equilibrium points; (6) is negative when capital is mobile and zero when it is not. The southern government's first order condition is isomorphic.

Major Results from the BTCM Literature

The key results are illustrated with (5) and (6). With symmetric nations I=Y, so:

> BTCM Result 1: Capital mobility results in a capital tax rate that is too low from the social perspective.

The key to wasteful tax competition is that *dn/dt* is negative (i.e. raising *t* lowers the tax base) when capital is mobile, so the RHS of (5) exceeds unity. This implies that taxes are too low, i.e. the marginal social benefit of taxation (i.e. W_G) exceeds its the marginal social cost (i.e. W_C). By contrast, immobile capital means *dn/dt=0* so the first best is

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[4] Note that dC/dt=-I+(dI/dn)(dn/dt), but by the envelope theorem dI/dn=0. Because there is no distortion between K and L employment when both are taxed at the same rate, a tax change that induces a small increase in capital employment raises output (GDP) by F_K, but since the extra capital must be paid F_K, there is no change in domestic income (GNP). Some BTCM versions tax only capital, so the K/L choice is distorted. In such cases, tax-induced changes in capital employment do affect I.

attained. The positive and policy corollaries of this are:

> BTCM Result 2: There should be a negative correlation between capital mobility and the tax rate on capital.
>
> BTCM Result 3: An upward harmonisation of capital tax rates can produce a Pareto improvement.

A second set of results corresponds to situations with asymmetric country size (size is measured by the supply of the fixed factor L). To be concrete, assume the north is larger, but that the two nations have identical relative factor endowments ($L>L^*$ but $K/L=K^*/L^*$). Given diminishing returns, it is clear that if taxes were equal in this setting, no capital would move because marginal products depend only of K/L. With this fact in mind, inspection of (6) shows that if taxes were equal, the north would have a lower dn/dt under our hypothesis since its n=K would be larger. But a glance at (5) reveals that in this case, the nations would have different tax rates, so our hypothesis of equal tax rates must be incorrect. Using the standard smoothness properties of a neoclassical economy, this line of thought demonstrates that the large country government will find it optimal to allow some of its capital to move abroad in exchange for setting its tax rate closer to the social optimal. Thus in equilibrium $t>t^*$, but also the capital-labour ratio is lower in the big country. To summarise:

> BTCM Result 4: Large countries should have higher tax rates than small countries, where size is defined in terms of supplies of the immobile factor.
>
> BTCM Result 5: The high tax country should have lower capital-labour ratios, i.e. there should be a negative correlation between tax rates and capital-labour ratios.
>
> BTCM Result 6: Large countries should export capital to small countries.

All these results turned on the impact of taxes on the mobile factor's spatial allocation, i.e. dn/dt. Since this is also the main topic of the new economic geography, and these models work with far richer underlying economies, it should be no surprise that a host of new insights emerges.

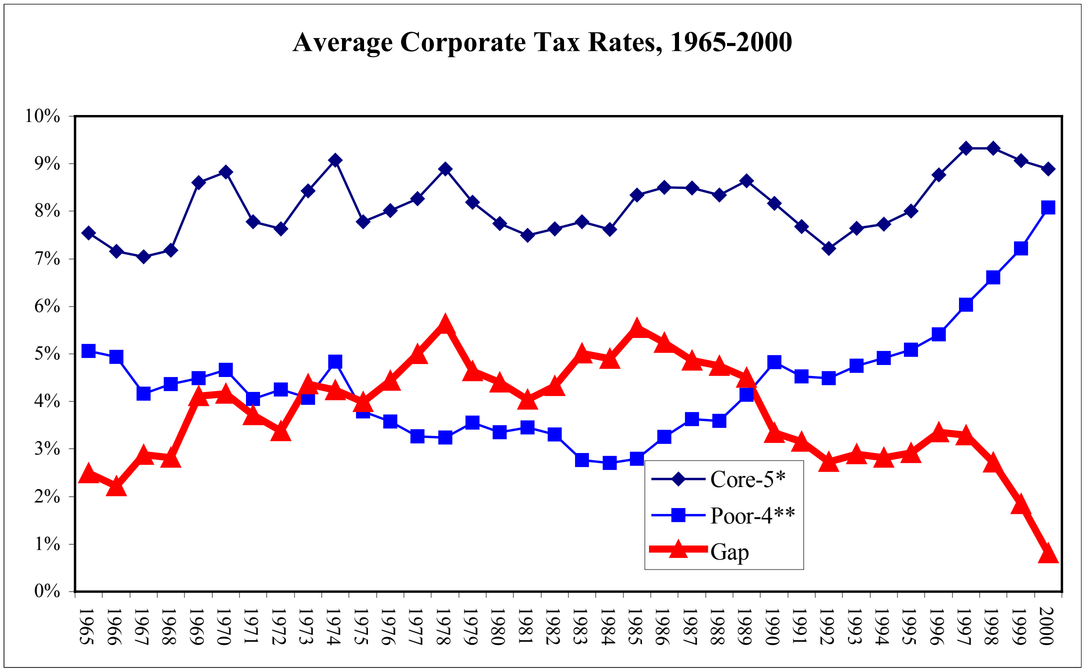
We turn next to whether one can construct a prima facie case for the race-to-the-bottom using the European data.

2.1. *Taxation in Europe: Stylised 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 centre, 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. We start by looking at *average* corporate tax rates since Devereux and Griffith (2002) show that the impact of tax on discrete investment decisions – which is typically the type of decision facing a multinational corporation looking for a production base – is not captured by the marginal rate.

Figure 1: Core and periphery average corporate tax rates, 1965-2000

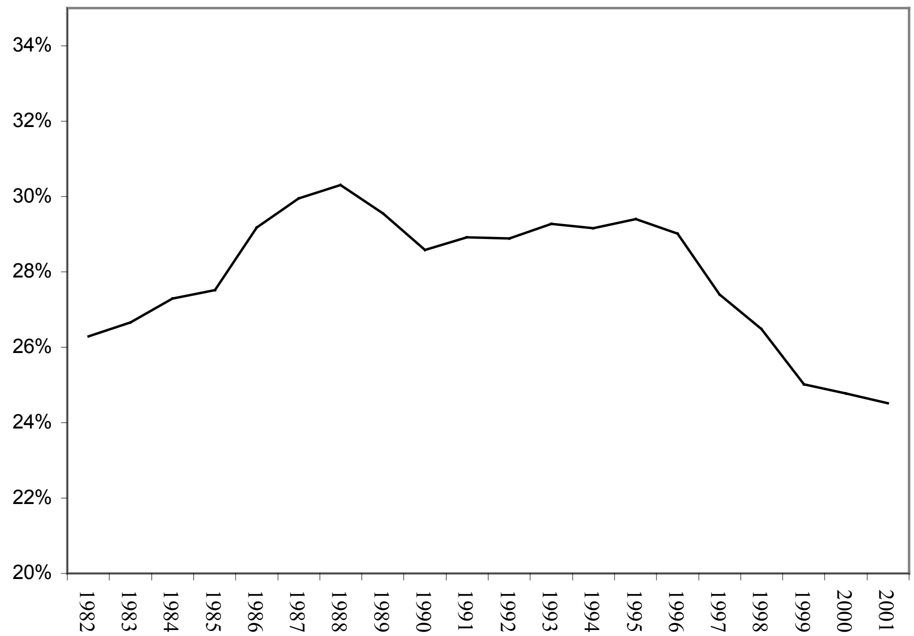


Notes: Corporate tax revenue/GDP. Core 5 = Unweighted average of Germany, Benelux, France, and Italy. Poor-4 = Unweighted average of Spain, Portugal, Ireland, Greece.
Source: Devereux, Griffith and Klemm (2002) http://ifs.org.uk/corptax/internationaltaxdata.zip

Figure 1 shows how the average corporate tax rate – that is, total corporate 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, the average corporate tax rate in the industrial core was fairly steady, fluctuating between 7% and 10%. If anything, the average has been climbing in recent years. The rate in the poor countries, on the other hand, fell from 1965 to 1984, but has climbed dramatically ever since. The data in this graph are certainly an imperfect measure of true tax burdens, especially those affecting marginal investment decisions, but they also do not look at all like a race to the bottom has accompanied Europe's integration.

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 mid 1980s, narrowing only more recently. Most of the narrowing, however, has stemmed from an upward movement of the poor-4's rates. 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. If anything, the graph suggests that there has been a race to the top.

Figure 2: Effective marginal corporate tax rate, average over 16 nations, 1982-2001



Notes: This is the effective marginal corporate tax rate with assumed inflation; see Devereux, Griffith and Klemm (2002) for details.
Source: Devereux, Griffith and Klemm (2002)

Total corporate tax collected as a share of GDP is a crude measure of a nation's taxation of mobile capital. Devereux, Griffith and Klemm (2002) have recently calculated a more sophisticated measure that takes account of the corporate tax base as well as the rate for 16 OECD countries – the EU15 (less Luxembourg and Denmark) plus the Canada, Japan and the US. Unfortunately, the authors note that rules on tax systems are difficult to collect, so they are able to go back only to 1982 – just a few years before the turning point suggested by the cruder data in Figure 1. The measure they calculate is the effective marginal tax rate. As Figure 2 shows, the rate in the average nation was rising until the late 1980s at which point is declines.

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. TAX COMPETITION WITH TRADE AND FACTOR MOBILITY

We present the model of the underlying economy before turning to the tax competition game. As shall become clear below, the key to our argument is the existence of agglomeration rents. Baldwin, Forslid, Martin, Ottaviano and Robert-Nicoud (2003) show that such rents arise in a wide range of economic geography models, including those of Krugman (1991) and Venables (1996). We thus conjecture that our results would hold in a broad range of models. To be concrete, and to be able to get analytic results, the model we adopt is a solvable variant of Krugman (1991) due to Forslid (1999).

3.1. Assumptions of the economic model

The model assumes two nations, each having two sectors and factors. Countries have identical preferences and technology, but may have different tax rates. The two nations are called north and south, and the two factors are called 'entrepreneurs' and 'workers'. Entrepreneurs are the mobile factor, so we refer to them as K; workers are immobile and denoted as L.

One sector, which we refer to as the agricultural sector, produces a homogeneous good using only workers according to constant returns technology and perfect competition. The cost function is wa_A, where w is the wage of workers and a_A is the unit input coefficient. The other sector, called the M sector, is monopolistically competitive and faces increasing returns in its production of differentiated varieties. Specifically, production of a typical variety of the manufactured good involves the services of one entrepreneur – this is the fixed cost – and a_M units of workers' labour for each unit of output produced. Thus the total cost of producing x units of a typical manufactured variety is $\pi+wa_Mx$, where π is the reward to entrepreneurs.

The representative consumer has preferences consisting of CES sub-utility over M-varieties nested in a Cobb-Douglas upper-tier function that also includes consumption of A, namely:

(7)
$$U = C; \quad C \equiv C_M^{\mu} C_A^{1-\mu}, \; C_M \equiv \left(\int_{i=0}^{n+n^*} c_i^{1-1/\sigma} di \right)^{1/(1-1/\sigma)}$$

where C_M and C_A are, respectively, the CES composite of M-varieties and A. Also, n and n^* are the mass (number) of north and south varieties, μ is the expenditure share on M-varieties, and σ is the constant elasticity of substitution between varieties; the regularity conditions we assume are $0<\mu<1<\sigma$.

Trade in the homogeneous A-good is costless, but trade in manufactured varieties is subject to iceberg trade costs, so that a firm wishing to sell one unit of its good in the other nation must ship $\tau\geq 1$ units since $\tau-1$ units 'melt' in transit. The south has analogous preferences, technology and trade costs.

3.2. Intermediate results and equilibrium expressions

This formulation yields a number of familiar results. Utility optimisation implies that a constant fraction of expenditure, μ, falls on industrial goods with the rest spent on C_A. It also yields a unitary elastic demand function for A and standard CES demand functions for varieties of the industry good, i.e.:

$$\textbf{(8)} \qquad c_j = \frac{p_j^{-\sigma}}{\int_{i=0}^{n+n^*} p_i^{1-\sigma}\, di}\mu E, \qquad C_A = (1-\mu)E / p_A$$

where p_j is the price of a typical variety j, p_A is the price of the homogenous good, and E is northern consumption expenditure. The south has analogous demand functions.

On the supply side, free trade in A equalises the price of A across nations and thus (via perfect competition and constant returns) equalises the wage rates of workers in both nations provided only that both countries produce some A – a condition that hold as long as $\mu<½$.[5] Thus trade in A equalises the wages of L, and taking southern L as numeraire, we have $p_A=w=w^*=1$.

With monopolistic competition, optimising M-firms engage in 'mill pricing', so north-based firms charge a consumer price equal to $a_M/(1-1/\sigma)$ in their local market and $\tau a_M/(1-1/\sigma)$ in their export market; southern firms set prices in an analogous fashion. Mill pricing also implies that operating profit is just $1/\sigma$ times sales. Using (8) and noting that an entrepreneur's reward is the operating profit of her variety, we have that the nominal reward to human capital (entrepreneurs) is:

$$\textbf{(9)} \qquad \pi = bB\frac{E^w}{K^w}; \qquad B \equiv \frac{s_E}{\Delta} + \phi\frac{1-s_E}{\Delta^*}, \; \Delta \equiv \phi + s_K(1-\phi), \; \Delta^* \equiv 1 - s_K(1-\phi), \quad b \equiv \frac{\mu}{\sigma},$$

where E^w and K^w are the level of world expenditure and world endowment of entrepreneurs, respectively, s_E is the north's share E^w, s_K is the north's share of the world endowment of entrepreneurs (human capital), and $\phi\equiv\tau^{1-\sigma}$ 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 we have used the fact that because each differentiated variety requires one unit of K, the north's share of world K is identical to the share of all varieties that are produced in the north. The expression for the southern reward to entrepreneurs, viz. π^*, is bB^*E^w/K^w with $B^*=\phi s_E/\Delta+(1-s_E)/\Delta^*$.

As an aside, observe that the B's show how the stabilising force, the so-called local competition effect, works in this model. As more of the mobile factor moves to the northern market, the number of north-based varieties in competition for northern expenditure rises and the number of south-based varieties in competition for southern expenditure falls. Holding constant the relative market sizes (i.e. s_E), this tends to lower π and raise π^*. Thus a shift in firms from south to north generates forces that tend to correct the initial delocation. For example, starting at the symmetric outcome, total differentiation of B, taking s_E as given, implies π falls by $-2(1-\phi)^2/(1+\phi)^2$ and by symmetry, π^* rises by $2(1-\phi)^2/(1+\phi)^2$. Freer trade weakens this stabilising force with its strength falling at approximately the square of the rate of opening.

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[5] Showing this involves intermediate results derived below, but anticipating them, we note that world expenditure on C_A is $(1-\mu)E^w$ and this must exceed the small nation's ability to make A; taking the south as the small nation it has $(1-s_L)L^w$ to make A (s_L is north's share of world labour), so since $E^w= L^w/(1-b)$, where $b=\mu/\sigma$, the no specialisation condition is $(1-\mu)>(1-s_L)(1-b)$. Since $s_L> ½$ by supposition and $b<1$, $\mu>½$ is a sufficient condition.

Entrepreneurs move to the region that affords them the highest level of utility, i.e. the highest post-tax real reward. As usual in models with agglomeration forces, this means there will be two types of outcomes: interior equilibria where the northern share of world capital – what we call s_K – is such that $0<s_K<1$ and post-tax rewards are equalised, and core-periphery (CP) outcomes, where $s_K=1$, or $s_K=0$, and the post-tax reward is higher in the 'core' nation. This paper focuses on the CP outcomes, in particular on the core-in-the-north outcome. The location condition for this outcome is:

$$\textbf{(10)} \qquad \frac{1-t}{1-t^*}\Omega^c \geq 1; \qquad \Omega^c \equiv \left.\frac{\pi / P}{\pi^* / P^*}\right|_{s_K=1}, \quad P \equiv \Delta^{-a}, \quad P^* \equiv (\Delta^*)^{-a}, \quad a \equiv \frac{\mu}{\sigma-1}$$

where P's are the perfect price indices corresponding to (7) and Ω^c is the 'agglomeration rent'.[6]

Inspection of the price indices shows how forward linkages work in this model. When entrepreneurs move from, say, south to north, they increase the share of all varieties made in the north. Since consumers bear the cost of trade, this factor movement makes life cheaper in the north and this, in turn, tends to make the north more attractive to the mobile factor. At the symmetric equilibrium, for instance a small south to north movement of industry lowers the P/P^* ratio by $a(1-\phi^2)/\phi^{1-a}$, this destabilising effect gets stronger with increases in the share of expenditure on industry μ and the operating profit margin $1/\sigma$, but it gets weaker as trade costs fall.

World expenditure is the sum of worker income, L^w, plus all entrepreneurs' income. Because total spending on manufactured goods is μE^w, mill pricing implies that entrepreneurial income worldwide equals bE^w thus $E^w=L^w/(1-b)$.[7] Since the north's expenditure equals $L+\pi s_K K^w$, (9) implies that the north's share of world expenditure, i.e. s_E just equals $(1-b)s_L+bBs_K$, where s_L is the north's share of world labour.[8] For convenience, we choose units of labour such that $L^w=(1-b)$, so E^w is unity, and we choose units of K such that $K^w=1$. Using the expression for B in (9), and gathering terms, we get the north's relative market size, i.e. its share of world expenditure, in terms of its share of workers, s_L, and its share of entrepreneurs, s_K:

$$\textbf{(11)} \qquad s_E = \frac{(1-b)s_L + b(\phi/\Delta^*)s_K}{1-b(1/\Delta - \phi/\Delta^*)s_K}$$

For simplicity we work with nations that have equal labour endowments, so we take the north's share of the world labour endowment, s_L, as equal to ½ here and in all subsequent expressions.

It is straightforward to show that the relative size of the northern market increases as its shares of workers and entrepreneurs rise. Expression (11) sheds light on how backward linkages function in this model. The movement of some of the mobile factor to

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[6] The location condition for an interior equilibrium is $(1-t)\Omega/(1-t^*)=1$ with Ω evaluated at $0<s_K<1$, and for the core-in-the-south outcome it is $(1-t)\Omega/(1-t^*)<1$ with Ω evaluated at $s_K=0$.

[7] Using (9) and its southern equivalent, $K^w[\pi s_K+\pi^*(1-s_K)]=bK^w$ since $Bs_K+B^*(1-s_K)=1$.

[8] That is, $s_E \equiv E/E^w=L/(L^w/(1-b))+(bB(E^w/K^w)s_K K^w/E^w$, which simplifies to the expression in the text.

the northern market makes the northern market bigger and, due to the home-market effect, this in turn tends to make the northern market more attractive to entrepreneurs. The amount of 'expenditure shifting' (i.e. ds_E) that comes with a small shift in production (i.e. ds_K), is $4b\phi/(1+\phi)/[1-b(1-\phi)/(1+\phi)]$ at the symmetric point. This destabilising effect becomes stronger with increases in the share of expenditure on industry μ and the operating profit margin $1/\sigma$.

Because the strength of the stabilising local competition effect falls roughly with the square of trade freeness, while the strength of the backward and forward linkages rise roughly linearly with trade freeness, the symmetric outcome is stable when trade is sufficiently closed. Moreover, there is a level of freeness, called the break point, at which the symmetric outcome becomes unstable. If trade is freer than the break point, a symmetric dispersion of industry is not stable. Moreover, similar reasoning implies that there is a level of trade openness, called the sustain point, beyond which full agglomeration of all industry in one region is stable. With symmetric regions, these points are:

(12) $$\phi^B = \left(\frac{1-a}{1+a}\right)\left(\frac{1-b}{1+b}\right), \qquad \phi^S : \ 1 = \frac{2\phi^{1-a}}{(1+b)\phi^2 + (1-b)}$$

where B and S indicate the break and sustain levels of ϕ. As usual, we cannot solve explicitly for the sustain point since $1-a$ is potentially a non-integer power. If full agglomeration is to be avoided with infinite trade costs – this is what Fujita, Krugman and Venables (1999) call the 'no-black-hole condition' – the breakpoint must be positive and this in turn requires $a>1$ since $b>1$ given our assumption that $0<\mu<1<\sigma$. We limit ourselves to parameter constellations that respect this condition.

Since the $\phi^S<\phi^B$ (see Forslid and Ottaviano, 2002 for an analytic proof), a gradual freeing up of trade flows will, in the presence of perfect capital mobility, eventually lead to full agglomeration of all industry in one nation. In this paper, we are concerned with tax competition when industry is already agglomerated in one nation, so we henceforth limit ourselves to $\phi>\phi^B$.

3.2.1. Bell-shaped agglomeration rent

Agglomeration forces in our model imply that K's real reward includes a location-specific agglomeration rent. That is, entrepreneurs located in the north are not indifferent between locations; they strictly prefer the north and would thus be willing to bear a higher tax in order to be in the north. As it turns out, this is bell-shaped in trade openness. Intuition for this is simple. When trade is impossible, agglomeration is not really possible since firms cannot serve both markets from a single location. When trade is completely free, agglomeration is useless since location is irrelevant. Thus it is at intermediate values of openness – where agglomeration is both feasible and useful – that the importance of agglomeration is greatest.

More precisely, the agglomeration rent is:

(13) $$\Omega^c \equiv \left.\frac{\pi / P}{\pi * / P *}\right|_{s_K=1} = \frac{\phi^{1-a}}{1-(1-\phi^2)(1+b)/2}$$

where this is found by using $s_K=1$ in (9) and (10). Five aspects of this ratio are important for what follows. First, the ratio is unity when trade is perfectly free ($\phi=1$), and it gets very negative as trade free-ness drops towards zero. The second point is that the agglomeration rent is bell-shaped, i.e. increasing in ϕ when trade is relatively closed yet decreasing in ϕ when trade is relatively open. To see this, we log differentiate (13):

(14) $$\frac{d\Omega^c / \Omega^c}{d\phi / \phi} = (1-a) - \frac{\phi(1+b)}{1-(1-\phi^2)(1+b)/2}$$

Since the first right-hand term must be positive by the no-black-hole condition, the second term is increasing in ϕ and is zero at $\phi=0$, the derivative is clearly positive up to some critical value of ϕ and after this it is negative. Solving (14), the top of the bell is at:

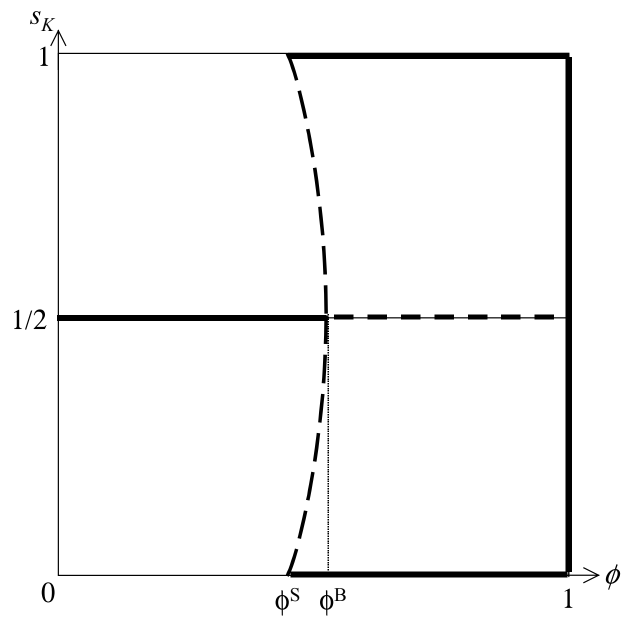
(15) $$\phi^{\max} = \sqrt{(\frac{1-a}{1+a})(\frac{1-b}{1+b})}$$

This expression is increasing in agglomeration forces as measured by '*a*' and '*b*'. The fourth point, which also follows directly from the definition of agglomeration forces and in any case is easily shown, is that the maximum Ω^c increases in the agglomeration forces. The final point concerning the agglomeration rent is obvious, but greatly eases the analysis when we model tax competition explicitly; Ω^c does not depends upon taxes, only on trade costs and parameters.

3.3. No tax equilibria

As a guide to intuition, we first solve the model when both tax rates are zero. In solving the model, the key variable is the division of the mobile factor K between north and south. There are two generic types of equilibria: interior equilibria where $\Omega=1$ and $0<s_K<1$, and corner solutions, where $\Omega>1$ and $s_K=1$, or $\Omega<1$ and $s_K=0$. In the economic geography literature, these corner solutions are called core-periphery outcomes. Not all types of equilibria exist for all levels of openness and not all are stable even when they do exist.

Figure 3: The 'tomahawk' diagram



The various possibilities are summarised in Figure 3. This diagram plots s_K against the free-ness of trade ϕ and shows the equilibria with bold lines (solid lines for stable equilibria and dashed lines for unstable equilibria). For $\phi<\phi^S$, the symmetric outcome $s_K=½$ is the only equilibrium and it is stable given the definition of the break point ϕ^B and the fact that $\phi^S<\phi^B$. For $\phi>\phi^B$, there are three equilibria: symmetry ($s_K=½$), the core in the north ($s_K=1$), and the core in the south ($s_K=0$). However, by definition of the break point ϕ^B, only the core-periphery equilibria are stable. Finally, for $\phi^S<\phi<\phi^B$, there are five steady states. Two are core-periphery outcomes and are stable, two are interior asymmetric equilibria and are unstable, and the last one is the symmetric outcome, which is also stable. When distance has no meaning, i.e. $\phi=1$, the location of production is not determined, so any s_K is an equilibrium. It is important to note that welfare is higher in the region with the 'core' since its cost of living is lower (consumers in the core avoid trade costs that consumers in the periphery must pay).

4. THE TAX GAME

The tax competition literature assumes that governments value tax revenue for one of two reasons. If the government is benevolent, tax revenue is used to finance public goods and the government cares about revenue since consumers like such goods. If the government is modelled as a 'Leviathan', i.e. it does not maximise social welfare, the government's objective is either to maximise the size of the state or to maximise its own utility, which may in turn depend on the probability of its re-election and its own wasteful consumption. In both the benevolent case and the Leviathan case, the government's objective is increasing in revenue and decreasing in the tax rate *per se*, but since the tax rate affects revenue, the total derivative of the objective with respect to the tax rate has an ambiguous sign. Indeed, the objective function has to be concave in the tax rate to get an interior solution when capital is immobile.

To focus on fundamentals and to avoid lengthy asides on political economy issues, we work with a reduced-form government objective function. This function is meant to capture the essential trade-off that is at the heart of any tax competition model – governments' desire to have high tax revenue but low tax rates. Specifically:

(16) $$W = W[G,t]; \qquad W_G > 0,\ G = tY, \quad Y \equiv wL + \pi K$$

where G is tax revenue and 't' is the tax rate; we assume that W is everywhere concave in t and increasing at t=0 so that the unconstrained problem for a government has an interior solution. Finally, to reflect the commonly observed fact that richer societies tend to prefer higher levels of taxation and government spending, we assume that taxation is a luxury good in the sense that the 't' which maximises W is higher for the rich nation, i.e. the nation in which all industry is agglomerated. The southern government has an isomorphic objective function.

We are interested in the case where industrial activity is already completely agglomerated in the north and in our simple model this means that the south literally has no industry to begin with, i.e. $s_K=1$. Specifically, we work with a three-stage tax game where the north (the nation that initially has the core) sets its tax rate 't' in the first stage, the south sets its rate '$t*$' in the second stage, and migration and production occur in the third stage. Clearly this structure maximises 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 given the lumpiness of the underlying economy. If the south chooses a sufficiently high tax rate, no industry/entrepreneurs will move from north to south; southern tax revenue is then just t^*L^*. If, however, the 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, namely $t^*(L^*+\pi K^w)$.

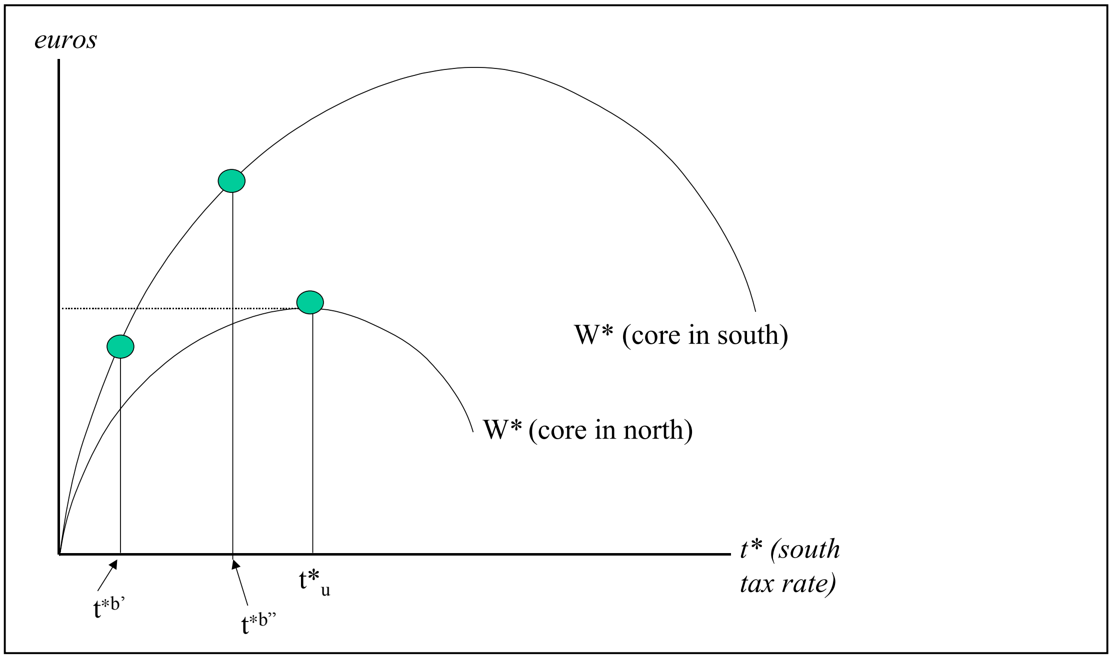
The first task is thus to find the threshold southern tax rate below which all firms will want to delocate from the north to the south. This 'break-point tax rate' – what we call $t*^b$ – is defined as the southern tax rate that would make a north-based firm just indifferent to moving south when all other firms were in the north. Thus, $t*^b$ solves what we call the "no delocation condition":

(17) $$(1 - t*^b) = \Omega^c(1-t)$$

Plainly, $t*^b$ depends upon t and Ω^c directly, with $t*^b$ rising with t and falling with Ω^c.

Figure 4 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 $t*$. The top bell-shaped curve is the southern objective function when the core has delocated to the south. The lower bell-shaped curve is the southern objective function when the core remains in the north. Taking t as set in stage one, we find the optimal southern tax rate by comparing the optimal t^* from the two cases. If the distribution of industry remains unchanged, i.e. the core stays in the north, the southern government is unconstrained by its desire to have the core, so it chooses t^* equal to t^*_u as shown in the diagram.

Figure 4: Second stage problem for southern government



The south's alternative is to set its rate low enough to 'steal' the core. Here the southern government's objective function is the upper bell-shaped curve, and in this case, t^* must be constrained to be no higher than t^{*b} – otherwise the core would stay in the north – and since the objective is increasing in t^* at this point, if the south decides to steal the core, it would set its rate at t^{*b}.

As noted, t^{*b} depends upon the tax rate set by the northern government in the first stage. Figure 4 shows two possibilities. When the north chooses a high tax rate, say t'', then t^{*b} is also high; for example, at the level marked as $t^{*b''}$ in the diagram. When the north chooses a low tax, say t', t^{*b} is also low, for example at $t^{*b'}$ in the diagram. As drawn, the southern government would lower t^* to $t^{*b''}$ – and thus steal the core – if the northern government had chosen t'' in the first period but not if it had chosen t'. In other words, if the north sets a very low tax rate in the first stage, the south will find it unattractive to set its tax rate low enough to take the core.

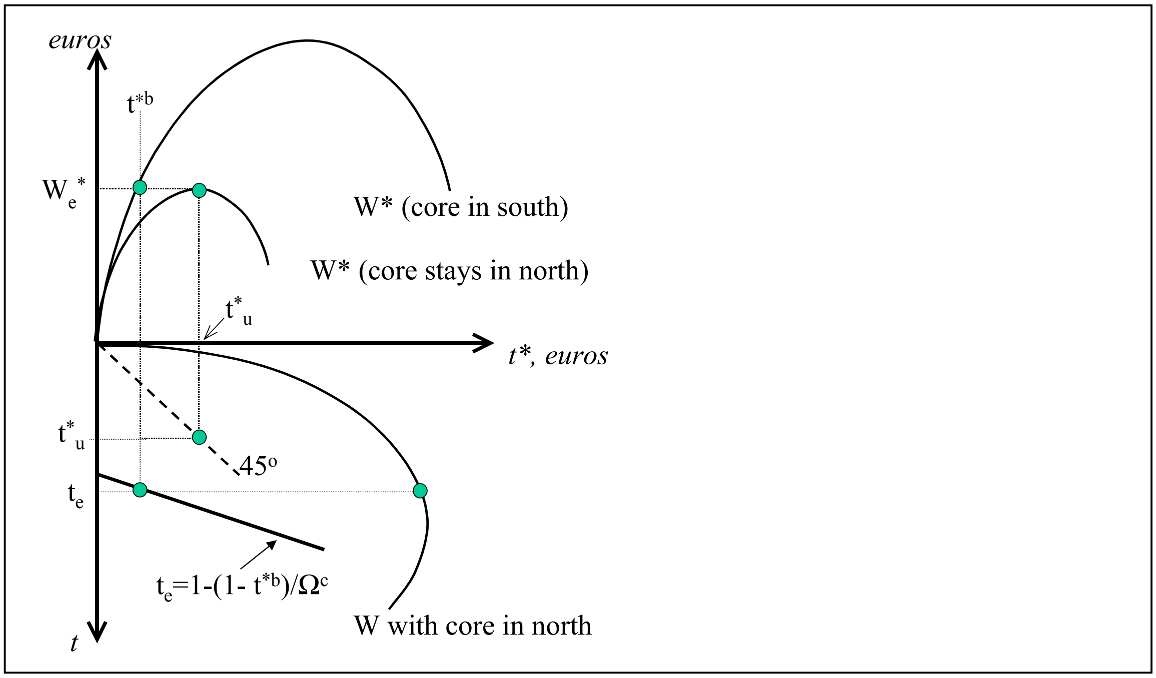
Of course in stage one the northern government is aware of its influence over the south's decision in stage two. In the first stage the north will presumably want to set its rate such that the south will *not* find it worthwhile to "snatch" the core. What the north has to do, then, is to push its tax rate low enough so that the south is indifferent between its unconstrained optimum without the core and its constrained optimum with it – a situation illustrated in Figure 5. The top panel of the diagram reproduces the stage-two game for the south, and the bottom panel shows the north's first-stage problem.

If the north wants to hold on to the core, it must set its equilibrium tax rate such that the south does not want to deviate from t^*_u. This in turn requires the "no deviation condition" to hold, that is:

$$\textbf{(18)} \qquad t_e = 1 - \frac{1 - t^{*b}}{\Omega^c} \quad \text{where } t^{*b} \ s.t.\, W^*[t^*_u Y^p, t^*_u] = W^*[t^*_u Y^c, t^*_u] \equiv W^*_e$$

where t_e is the north's equilibrium rate. Also, Y^p and Y^c are the south's income when it is, respectively, the periphery or core nation. Specifically, $Y^p=L^w/2$ and $Y^c=L^w/2+\pi K^w$.[9]

Figure 5: First stage play



We must also check that the north actually prefers the tax rate it needs to keep the core, but since we assume s_L=½, this is easy. The north's 'with-core' and 'without-core' objective functions are the same as those for the south, so we can use the top panel of Figure 5 to conduct the analysis. In particular, if the north allowed the south to capture the core, the north would find itself in the same situation as the south does in equilibrium. Consequently, the level of its objective function would be equal to W_e^* in Figure 5. By contrast, when north plays t_e and keeps the core, the level of its objective function is higher than W_e^* because t_e exceeds t^{*b} and t^{*b} is defined as the tax level where a nation with the core would be indifferent to not having it. What all this goes to say is that the north will always "limit tax" the south when it has the core.

Plainly this "limit tax" game is akin to the equilibrium of a Stackleberg oligopoly game where the leader limit-prices a potential entrant. We turn now to studying the gap between the north's and the south's equilibrium tax rates.

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[9] Given (9) and our normalisation of E^w and K^w to unity, $Y^c=(1+b)/2$ and $Y^p=(1-b)/2$.

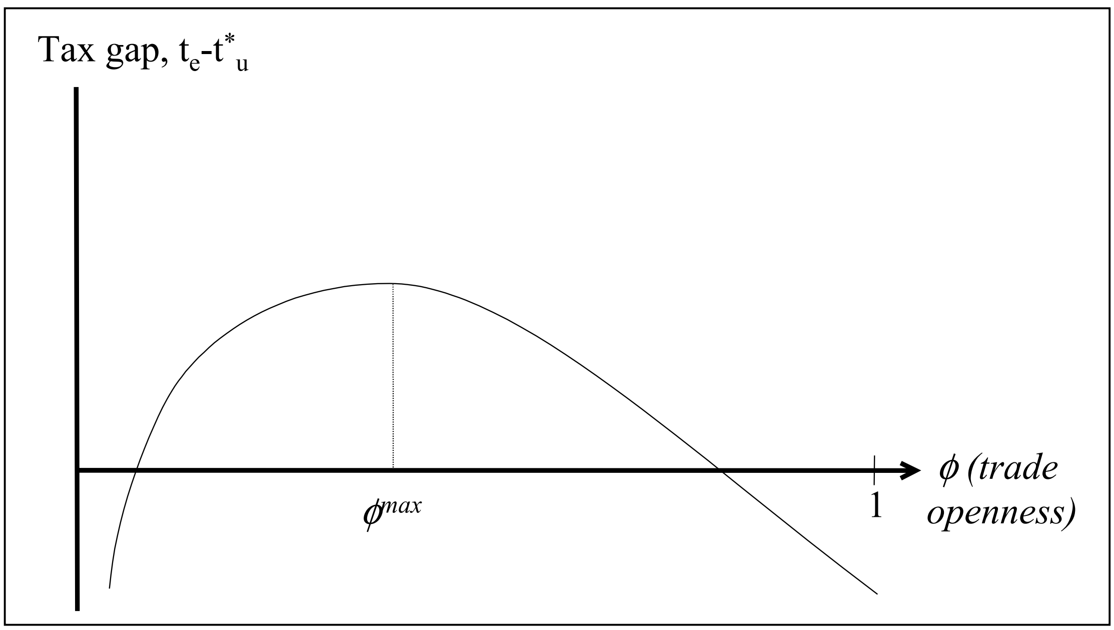
4.1. Equilibrium tax gap

The first point is that the equilibrium tax gap, i.e. t_e-t^*_u, is bell-shaped. Starting from a low level of openness, making trade freer first increases the gap, but then decreases it. The reason is plain. The south's equilibrium tax rate t^*_u and its deviation tax rate, t^{*b}, do not depend upon trade freeness since W^* does not. But taking a log approximation of the no-delocation condition, the north's rate t_e is approximately t^{*b} plus $ln(\Omega^c)$, and this means that the gap is bell-shaped since Ω^c is bell-shaped. The maximum gap occurs at the ϕ where Ω^c is maximised, namely at ϕ^{max} as given in (15).

Another easily established result is that when trade is almost perfectly free, the tax gap is negative, i.e. the core must have a lower tax rate in order to retain the core. In particular, since $\Omega^c=1$ with $\phi=1$, the no-delocation condition implies $t_e= t^{*b}$ and the no-deviation condition implies that $t^{*b}<t^*_u$. These two points tell us that the tax gap is bell-shaped and the right-most point of the bell is negative.

Comparing the absolute levels of the equilibrium tax rates over the full range of trade costs is more difficult since Ω^c involves non-integer powers and the distance between t^{*b} and t^*_u depends the functional form of W. To study this analytically, we adopt a specific functional form for the governments' objective function.

Figure 6: Trade openness and international tax competition



4.1.1. Specific functional forms

Since the W function must be concave in the tax rate, we use the quadratic approximation for the north's objective function:

(19) $$W = G - t^2/2; \qquad G = t(L + \pi K)$$

and $W^*=G^*-(t^*)^2/2$. Using the steps described above, we get:

(20) $t_u^* = \dfrac{1-b}{2}, \quad t^{*b} = \dfrac{1+b}{2} - \sqrt{b}, \quad W_e^* = \dfrac{(1-b)^2}{8}, \quad t_e = 1 - \dfrac{(1-b)/2 + \sqrt{b}}{\Omega^c}$

Using this and (13), we have:

(21) $$t_e - t_u^* = \frac{1+b}{2} - \left((1-b) + 2\sqrt{b}\right)\frac{2-(1-\phi^2)(1+b)}{\phi^{1-a}}$$

While this north-south tax gap is bell-shaped as mentioned above, we cannot readily determine whether there are any levels of trade freeness for which the core has a higher tax rate, since Ω^c involves the non-integer power, *1-a.*

What we can do is to show that the core will have a higher tax rate when agglomeration forces are strong enough. To this end, note that the strength of agglomeration forces is limited by the no-black-hole condition $a \leq 1$, so by setting $a=1$ we consider the strongest allowable agglomeration forces. Moreover, the agglomeration rent is maximised at the level of openness given by (15). We thus plug $a=1$ and $\phi=\phi^{max}$ into (15) to find that Ω^c equals $2/(1-b)$. Using this result and the fact that $\phi^{max}=0$ when $a=1$ together with (21), the maximum tax gap can be written as:

(22) $$t_e - t_u^* = \frac{\sqrt{b}(2\sqrt{b}-1)}{2} + \frac{1-b^2}{4} + \frac{b\sqrt{b}}{2}$$

which is positive since $b<1$. Using the bell-shaped nature of the tax gap and the fact that it is positive at some level of ϕ^{max}, we know that the connection between trade openness and the equilibrium tax gap looks like the curve shown in Figure 6.

Note that we would never find the north's rate higher than the south's if the unrestricted maximum of each region's objective function were the same. The point is simple. Because the south sets its rate at the unconstrained maximum, the northern government would never want to have a higher rate. This is why we had to assume that the summit of the top bell-shaped curve in Figure 4 was to the right of the bottom bell-shaped curve.

4.2. Modifications of BCTM results

The fact that the core nation has a higher tax rate suggests a number of results that are counter to those of the basic tax competition model (BTCM). Specifically:

> Result 1 (trade costs matter): The equilibrium gap between the big and the small nations' tax rates depends upon the integration of goods markets as well as the mobility of capital (Ludema and Wooton, 1998).

Closer goods market integration raises the gap when markets are relatively closed, but reduces the gap when trade is relatively free.

> Result 2: When agglomeration forces are sufficiently strong and capital is internationally mobile, we should observe a *positive* correlation between capital-labour ratios and tax rates, i.e. the industrialised regions should have

higher tax rates other things equal. (The BTCM predicts a negative correlation.)

Result 3: When size is defined in terms of supplies of the immobile factor (as in the BTCM), international tax competition in the presence of agglomeration forces and capital mobile may lead same-sized nations to have different equilibrium tax rates.

In particular, when trade is sufficiently free, industry will agglomerate in one nation and that nation's government may tax capital at a higher rate without losing capital due to the presence of agglomeration rents. By contrast, the BTCM predicts same-sized-nations will have equal tax rates.

Stepping slightly outside the analysis above, we can suggest a further result. Starting with trade restricted enough to support the symmetric outcome (i.e. $\phi<\phi^B$, so $s_K=½$), but increasing the degree of openness, we would see the emergence of the core-periphery outcome with the mobile factor flowing from south to north. Although a full analysis of this possibility would require detailed dynamic reasoning, we conjecture that we would see the high tax nation being an importer of capital. This contradicts the BTCM prediction.

4.2.1. No capital mobility

The main axis of investigation in the tax competition literature is the degree of capital mobility, so we consider the impact of perfect versus zero capital mobility on equilibrium tax rates. When there is no capital mobility, each region charges its unconstrained tax rate. Compared to the situation described above, this implies no change for the periphery region, but allows the core region to raise its tax rate (this can be seen clearly in Figure 5). In other words, the primary result of the BTCM – that tax competition leads to rates that are too low – is modified by the inclusion of agglomeration forces; tax competition and capital mobility lead only one of the two governments to be constrained in its choice of tax rates. In a 'lumpy' economy, only the core region needs to modify its taxes to keep the core. The south, which realises that the north will never let it win the core, sets its rate without regard to the northern tax rate. In other words, tax competition is a one-sided affair when agglomeration forces are important.

4.2.2. No agglomeration forces

In this model we can, in the limit, eliminate agglomeration forces and imperfect competition by allowing σ to get arbitrarily large. From (12) and the definitions of *a* and *b*, the break point level of trade free-ness limits to unity as σ approaches infinity. What this means is that the core-periphery outcome would never arise with positive trade costs, so the nations' incomes would be symmetric. Given (16), the equilibrium tax rates would be symmetric. Moreover, the spatial division of capital is a continuous variable at the symmetric outcome and since symmetry is stable without agglomeration forces, we would find that s_K responded negatively to northern taxation. This, of course, would put us back in the BTCM world where symmetric countries compete over capital. While working this possibility out thoroughly is beyond the scope of this paper, the logic of the

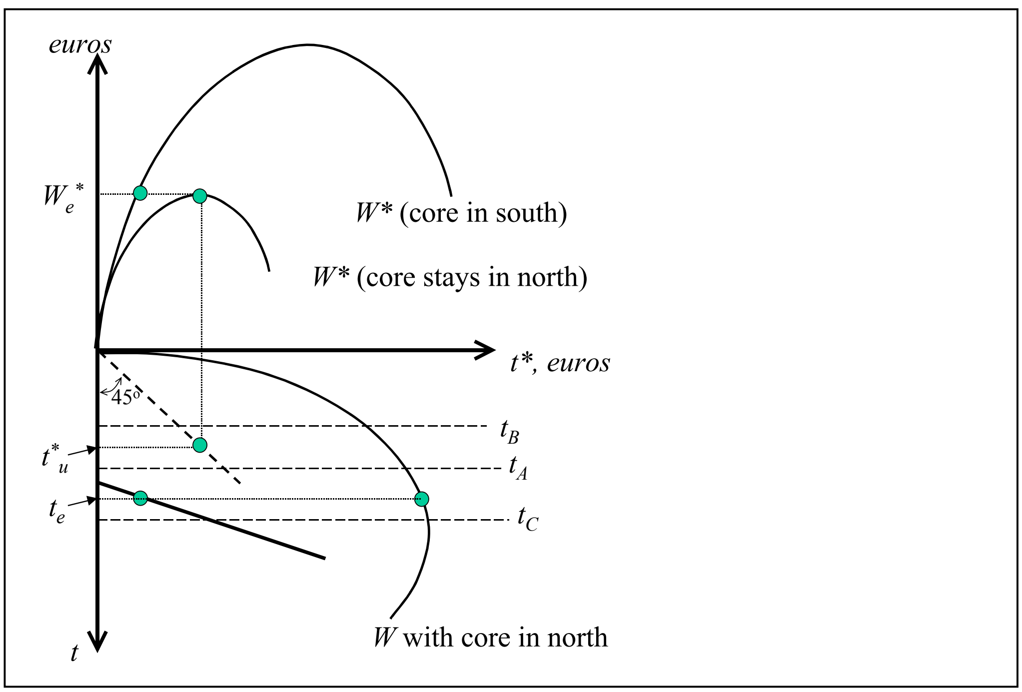
BTCM suggest that the equilibrium tax rates would be below those that would be set without capital mobility.

5. TAX HARMONISATION

As it turns out, this setup suggests that tax harmonisation has somewhat unexpected results. In the basic tax competition model, tax harmonisation basically entails a shift from a non-cooperative tax game to a cooperative tax game; Pareto improvement from the government's perspective follows by definition. In stark contrast, harmonisation makes one or both countries worse off when agglomeration forces are present.

To see this, consider first the most straightforward tax harmonisation scheme, i.e. adoption of a common rate that lies between the two initial rates, i.e. t_e and t_u^*. As it turns out, this split-the-difference harmonisation makes both the north and the south worse off as Figure 7 shows. First, note that this single rate, t_A in the diagram, would not lead to a shift in the core from the north to the south since with equal taxes, firms prefer to stay agglomerated in the north. Given that the south remains without industry, its loss follows directly from the fact that its pre-harmonisation rate was an unconstrained maximum. Losses for the north are similarly clear. Compared to the initial equilibrium, the harmonisation forces the north to lower its tax rate, when in fact it would have preferred to raise it.

Figure 7: Split-the-difference tax harmonisation



A second possible candidate for the single-rate harmonisation would entail a rise in both nations' rates to something like t_c in the diagram. Here the north would gain (since its tax-competition constraint would be relaxed) but the 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. Lowering both rates to something like t_B would make both governments worse off.

In our model, in contrast to the basic tax competition model, it is easy to understand why there is no single rate that nations could agree upon. In a lumpy world, tax competition is a rather one-sided affair. The tax rate of the core nation is constrained by competition, while that of the periphery nation is not. Consequently, there is no mutual gain to cooperation. To summarise:

> Result 4: In contrast to the BTCM result, upward harmonisation of tax rates in the presence of capital mobility is not a Pareto improvement. In fact harmonising tax rates at any single level makes one or both nations worse off.

While the most straightforward tax harmonisation 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 the equilibrium tax rate of the low-tax nation. The reasoning is straightforward. In order 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 t^{*b}. And this despite the fact that the south ends up charging the higher rate t^*_u in equilibrium. By setting the minimum just below the south's equilibrium rate, the minimum tax scheme rules out the off-equilibrium t^{*b} by fiat. Given this, the north can now base its rate on the higher equilibrium southern rate t^*_u. This effectively relaxes a binding constraint on north's choice, so the tax-floor-scheme raises the level of the north's objective function. The scheme has, by construction, no impact on the south's situation. Thus:

> Result 5 (tax-floor harmonisation): A tax floor set just below the lowest equilibrium tax rate improves the situation for the north without harming the south.

6. CONCLUDING REMARKS

This paper looks at the impact of tighter goods market integration on international tax harmonisation and tax competition when agglomeration economies are significant. 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. Agglomeration forces mean that 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 can, 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 one sided. The core finds its tax rate constrained by potential competition from the periphery, but since the core limit taxes the south 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 corporate 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) keep their rates approximately steady while less industrialized periphery nations (Spain, Portugal, Ireland and Greece) lowered theirs. Integration has continued in the 1980s and during this integration phase, tax gaps narrowed, but much of the gap narrowing came from rising periphery tax 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 harmonisation. The traditional analysis, based on Nash tax competition, views tax harmonisation as a shift from a non-cooperative outcome to a cooperative one; harmonisation is thus likely to improve the lot of all nations (or at least their governments). In our model, simple tax harmonisation – 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 nation gaining and the low-tax nation being left indifferent.

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