DISCUSSION PAPER SERIES

No. 3638

MARKET ACCESS AND TAX COMPETITION

Gianmarco I P Ottaviano
and Tanguy van Ypersele

INTERNATIONAL TRADE and PUBLIC POLICY

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP3638.asp**

ISSN 0265-8003

MARKET ACCESS AND TAX COMPETITION

Gianmarco I P Ottaviano, Universita di Bologna and CEPR
Tanguy van Ypersele, Université de Namur, CORE and CEPR

Discussion Paper No. 3638
November 2002

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 3638

November 2002

ABSTRACT

Market Access and Tax Competition*

In this Paper, we show that with international externalities, different country sizes, imperfect competition and trade costs, tax competition for mobile firms is efficiency-enhancing with respect to the free market outcome. Nonetheless, while the latter entails too many firms in the larger country, the former has too many firms in the smaller one. Under both scenarios the resulting inefficiencies in international specialization and trade flows vanish when trade costs are low enough. Otherwise, only international tax coordination can implement the efficient spatial distribution of firms.

JEL Classification: F12, F22, H23, R13 and R23
Keywords: capital mobility, monopolistic competition, tax competition and trade

Gianmarco I P Ottaviano
Istituto di Economia Politica
Università Commerciale L Bocconi
Via Gobbi 5
20136 Milano
ITALY
Tel: (39 02) 5836 5450
Fax: (39 02) 5836 5314
Email: gianmarco.ottaviano@uni-bocconi.it

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=125330

Tanguy van Ypersele
FUNDP Namur and Core
Université de Namur
Rempart de la Vierge, 8
B-5000 Namur
BELGIUM
Tel: (32 81) 72 4846
Fax: (32 81) 72 4840
Email: tanguy@fundp.ac.be

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=133931

*This Paper is produced as part of a CEPR Research Network on 'The Economic Geography of Europe: Measurement, Testing and Policy Simulations', funded by the European Commission under the Research Training Network Programme (Contract No: HPRN-CT-2000-00069). We are indebted to Signe Krogstrup, Karen-Helene Midelfart-Knarvik, and Ian Wooton, as well as seminar participants in Bologna, Modena, Madrid, Valencia, Alghero, ERWIT2002 in Münich, Paris I, Villars, and Namur.

Submitted 04 October 2002

1 Introduction

Economic integration as we know it dismantles barriers to goods and factors mobility while allowing governments to function independently in most policy areas. In particular, a presumption in favor of this independence seems to be reflected in the founding principles of regional trade agreements in Europe as well as North and South America. All this raises the natural issue whether such independence is indeed a good thing or not.

The present paper investigates that issue from a specific point of view, namely, from the perspective of tax competition for mobile capital. More precisely, it aims at answering three related questions. First, does tax competition distort the international allocation of capital, thus yielding an inefficient international specialization in production? Second, does tax competition distort the pattern of international trade, thus yielding inefficient shipments of goods across countries? Third, if such inefficiencies exist, are they related to the extent of trade integration?

These questions have been explored in various directions. First of all, the presence of international externalities can make tax competition wasteful. This is the case, for example, when a rise in one country's tax rate increases capital supply in other regions due to tax arbitrage by capital owners. As a national government neglects this positive effect on other countries' capital supply, tax rates and public good provisions are inefficiently low. Two caveats are in order. On the one hand, such inefficiency is mitigated even if not removed when countries are able to influence the international remuneration of capital. On the other, though tax competition is globally inefficient, it can nonetheless benefit some countries. For example, when countries differ in size, tax rates are higher in larger countries and smaller countries can be better off with than without tax competition ('importance of being small'). Thus, the inefficiency costs of tax competition are unevenly borne by regions with different sizes (Bucovetsky, 1991; Wilson, 1991).

Tax competition can be even efficiency-enhancing when firms are imperfectly competitive.[1] Janeba (1998) studies a model in which two countries compete for two duopolists that serve a third market through exports. When firms are exogenously assigned to different countries, government engage in

[1] An imperfectly competitive market is not the only case in which tax competition can enhance efficiency. Other cases arise when firms production capacity is lumpy (Black and Hoyt, 1989), governments face commitment problems (Kehoe, 1989), or tend to be oversized due to rent-seeking behavior (Edwards and Keen, 1996).

wasteful export subsidies. On the contrary, when firms are mobile, tax competition drives the tax rates to zero. This result rests on equal-sized countries facing an infinitely elastic supply of capital. In terms of the questions raised above, the assumption of equal sized countries is particularly disturbing in that it rules out international specialization. Moreover, since Janeba (1998) does not consider trade costs, his contribution does not provide any insight on the interaction between trade integration and tax competition.

Imperfect competition together with trade barriers can also reverse the 'importance of being small'. Haufler and Wooton (1999) consider two countries competing for a monopolist. They show that, even if the larger country ends up imposing higher taxes, it nonetheless wins the competition since trade costs give it a location advantage due to better market access ('importance of being big'). **More generally,** what is crucial for size to give an advantage in terms of tax competition is the fact that, with imperfectly competitive firms and trade costs, the larger country faces a lower elasticity of capital supply. This insight is developed in models in which, given two initially identical countries, trade integration causes mobile factors to agglomerate in one country only. Ludema and Wooton (2000) as well as Kind, Midelfart-Knarvik and Schjelderup (2000) show that agglomeration economies generate a locational rent that can be taxed away by the local government without inducing relocation. That is, by fostering agglomeration, trade integration leads to a decrease in the intensity of tax competition.[2] In terms of the questions we raised above, all these models lack a detailed welfare analysis, which makes them silent about the desirability of tax competition. A partial exception is represented by Baldwin and Krugman (2000) who show that international tax coordination via full harmonization or via the introduction of a minimum capital tax generally harms at least one country.

To sum up, the existing literature identifies the basic requirements that a model must satisfy in order to tackle the questions raised above. Such requirements are international externalities, asymmetric sizes, imperfect competition, and trade costs. To the best of our knowledge there exists no model fulfilling all those requirements while providing at the same time a full-fledged global welfare analysis. This is the gap we want to fill in by this paper.

The paper is organized in six additional sections. The first develops a general equilibrium model in which two countries compete for monopolisti-

[2]In addition, Anderson and Forslid (1999) show that tax competition per se may act as an agglomeration force.

cally competitive firms à la Ottaviano, Tabuchi and Thisse (2002). Countries have asymmetric sizes and trade is costly so that the larger country provides a better overall market access. Following Persson and Tabellini (1992) taxes exist only to redistribute income, so as to abstract from the efficiency of public goods provision. The second section characterizes the free market outcome showing that it yields a 'home market effect': the larger country hosts a more than proportionate share of firms (Helpman and Krugman, 1985). In the third section, this outcome is shown to be inefficient because, unless trade costs are low enough, too many firms are located in the larger country. The fourth section characterizes the tax competitive outcome in which the location of firms is less concentrated than the free market one. Moreover, the fifth section shows that, unless firms are all clustered in one country, tax competition is efficiency-enhancing with respect to the free market. Nonetheless it overshoots in the opposite direction with too many firms located in the smaller country. Under both free market and tax competition the inefficiencies in international specialization and trade flows vanish when trade costs are low enough. Otherwise only international tax coordination can implement the efficient spatial distribution of firms. The sixth section concludes.

2 The model

The economy consists of two countries, H and F, which are endowed with two factors, capital K and labor L. Labor is geographically immobile, its total stock equals L, and it is distributed so that a σL workers reside and work in country H with $0 < \sigma < 1$. Capital is perfectly mobile, its total stock equals K, and it is distributed so that σK units are owned by country H workers while γK units are used in country H production with $0 < \gamma < 1$. Hence, $(\gamma - \sigma)K > 0$ (< 0) measures capital inflows to (outflows from) country H from (to) country F. Finally, we assume that country H is 'larger' than country F, that is, $\sigma > 1/2$.

A. Consumers

Following Ottaviano, Tabuchi, and Thisse (2002), preferences are identical across individuals and captured by a quasi-linear utility function, which is symmetric as well as quadratic in a continuum of horizontally differentiated varieties $i \in [0, N]$ and linear in a homogenous good O. The associated indirect utility function is:

$$V(y;p(i),\, i\in[0,N]) = \frac{a^2N}{2b} - a\int_0^N p(i)di + \frac{b+cN}{2}\int_0^N [p(i)]^2 di \qquad (1)$$
$$-\frac{c}{2}\left[\int_0^N p(i)di\right]^2 + y + p_O\overline{q}_O$$

with $a, b > 0$ and $c \geq 0$. In (1), $p(i)$ is the price of variety i, y the consumer's income, $\overline{q}_0$ her initial endowment of the homogenous good and p_O its price. The presence of the term $\int_0^N [p(i)]^2$ reflects the consumer's love for variety, while c is a direct measure of the substitutability between varieties ($c = 0$ means no substitutability). Finally, the initial endowment $\overline{q}_O$ in the homogenous good is assumed large enough for the consumption of the numéraire to be strictly positive at the market equilibrium and optimal solutions.

Applying Roy's identity to (1) yields the following demand for variety i:

$$q(i) = a - bp(i) + c\int_0^N [p(j) - p(i)]dj \qquad (2)$$

which shows that the quantity demanded of a variety is a decreasing function of its own price and an increasing function of other varieties prices.

In the sequel, we focus on country H keeping in mind that things pertaining to country F can be derived by symmetry. Accordingly, we can use (2) and the assumption of symmetry between varieties to write the individual demands by a consumer in H for two representative varieties produced in H and F respectively:

$$q_{HH} = a - (b + cN)\, p_{HH} + cP_H \qquad (3)$$

$$q_{HF} = a - (b + cN)\, p_{HF} + cP_F \qquad (4)$$

where p_{HH} (p_{HF}) is the price set in H (F) by a firm located in H and

$$P_H \equiv n_H\ p_{HH} + n_F\ p_{FH}$$

$$P_F \equiv n_H\ p_{HF} + n_F\ p_{FF}$$

Most naturally, P_H/N and P_F/N can be interpreted as the price indices (i.e. the average prices) prevailing in countries H and F. Therefore, in a certain market the demand for a typical variety increases (decreases) if the local price index increases (decreases).

B. Firms

The differentiated varieties and the homogeneous good are supplied by two different sectors, *modern* and *traditional*. The modern sector supplies varieties under increasing returns to scale and monopolistic competition. Specifically, the production of any variety requires a fixed amount ϕ of capital K. Horizontal differentiation then implies that, in equilibrium, a one-to-one correspondence between varieties and firms so that from now on, we will use the two terms interchangeably. Accordingly, N is the total number of both varieties and firms. The traditional sector produces a homogeneous good under constant returns to scale and perfect competition. It uses labor L as the only input with one unit of L required to produce one unit of output. This good is freely traded and is chosen as the numéraire ($p_O = 1$).

On the contrary, the varieties of the modern sector are traded at a cost of τ units of the numéraire per unit shipped between the two countries. Firms are assumed to take advantage of positive trade costs to segment markets, that is, each firm sets a price specific to the market in which its product is sold. This is consistent with empirical evidence that shows that firms succeed to price discriminate between spatially separated markets even within an integrated economic area (Head and Mayer, 2000).

Using (3) and (4), a representative firm in H maximizes profits:

$$\begin{aligned}\Pi_H = p_{HH}\ [a - (b + cN)\, p_{HH} + cP_H]\ \sigma L + \\ (p_{HF} - \tau)\ [a - (b + cN)\, p_{HF} + cP_F]\ (1 - \sigma)L - \phi r_H\end{aligned} \tag{5}$$

where r_H is return to capital prevailing in H. In so doing, the firm takes the price indices as given: since there is a continuum of firms, each one is negligible in the sense that its action has no impact on the market. At the same time, the market as a whole has a non-negligible impact on each firm's choice in that each firm must account for the distribution of all firms' prices through an aggregate statistics (the price index) in order to find its equilibrium price. As a consequence, our market solution is given by a Nash equilibrium with a continuum of players in which prices are interdependent.

Solving the first order conditions for profit maximization with respect to prices yields:

$$p_{HH} = \frac{1}{2}\frac{2a + \tau c N(1-\gamma)}{2b + cN} \tag{6}$$

$$p_{FF} = \frac{1}{2}\frac{2a + \tau c N\gamma}{2b + cN} \tag{7}$$

$$p_{HF} = p_{FF} + \frac{\tau}{2} \tag{8}$$

$$p_{FH} = p_{HH} + \frac{\tau}{2} \tag{9}$$

Substracting τ from (8) and (9), we see that firms' prices net of trade costs are positive regardless of the firms' distribution if and only if

$$\tau < \tau_{trade} \equiv \frac{2a\phi}{2b\phi + cK} \tag{10}$$

The same condition must hold for consumers in F (H) to buy from firms in H (F), i.e. for the demand (4) evaluated at the prices (8) and (9) to be positive for all γ. From now on, condition (10) is assumed to hold. Hence, we consider a setting in which there is a priori intra-industry trade whatever the distribution of firms.

Notice that equilibrium prices depend on trade costs, on the total number of active firms as well as on their distribution between the two countries. In particular, (10) implies that an increase in the number of firms in the economy leads to lower prices for the same spatial distribution $(\gamma, 1-\gamma)$ because there is more competition in each local market. For similar reasons, for given N, the prices charged by both local and foreign firms in H (F) fall when γ increases (decreases) because local competition gets fiercer. Provided that (10) holds, equilibrium prices also rise when substitutability between varieties falls (lower c). Furthermore, home sales rise while foreign sales fall with τ because of the higher protection enjoyed by domestic firms.

Finally, it is readily verified that

$$p_{HF} - p_{HH} = \tau\frac{b + c\gamma N}{2b + cN} < \tau \tag{11}$$

which shows that only a fraction of the trade cost is passed on to distant consumers. In particular, freight absorption by firms located in H is a decreasing function of their relative number. The reason is that as γ falls, the market in country F becomes more crowded pushing down local prices. This implies that the elasticity of demand for firms located in H rises on foreign sales while falling on domestic ones. Therefore, they find it convenient to reduce their operating margins on foreign sales while increasing them on domestic sales (Brander and Krugman, 1983).

3 Free market location

Capital market clearing implies that the number n_H of firms belonging to the modern sector and located in country H is equal to:

$$n_H = \gamma K/\phi \tag{12}$$

so that the number of firms in F is

$$n_F = (1-\gamma)K/\phi \tag{13}$$

Hence, in each country the number of active firms is determined by the stock of capital that is used locally so that any change in the geographical distribution of firms originates from a corresponding change in the geographical employment of capital. Moreover, (12) and (13) imply that the total number of firms (varieties) in the economy is fixed by endowments and technology and equal to $N = K/\phi$.[3]

Firms' entry and exit are free so that profits are zero in equilibrium. Given (12) and (13), the corresponding equilibrium returns to capital are determined by a bidding process among firms which ends when no firm can earn a strictly positive profit at the equilibrium market prices. Substituting (6) and (8) into (5), imposing the zero profit and solving the resulting equation in r_H yields a quadratic function of γ:

$$\begin{aligned} r_H(\gamma) = \frac{b\phi + cK}{4(2b\phi + cK)^2\phi^2} \big\{ & [2a\phi + \tau cK(1-\gamma)]^2 \sigma L \\ & + [2a\phi - 2\tau b\phi - \tau cK(1-\gamma)]^2 (1-\sigma)L \big\} \end{aligned} \tag{14}$$

[3] Formally, both K and N are continuous variables. They can be thought of as two segments of different length with ϕ being the factor of proportionality.

A symmetric expression holds for r_F:

$$r_F(\gamma) = \frac{b\phi + cK}{4(2b\phi + cK)^2\phi^2}\left\{[2a\phi + \tau cK\gamma]^2 (1-\sigma)L \right. \\ \left. + [2a\phi - 2\tau b\phi - \tau cK\gamma]^2 \sigma L\right\} \tag{15}$$

Both $r_H(\gamma)$ and $r_F(\gamma)$ are convex functions of γ. As to the former, standard, but cumbersome, investigation reveals that $r_H(\gamma)$ is decreasing in the share γ of firms in H. In other words, the equilibrium return to capital in H falls as the number of local firms rises. This effect gets weaker and weaker as γ increases because the larger the number of local firms, the weaker the marginal impact of a new entrant on the intensity of local competition. This stems from the fact that rising γ stregthens competition in H while weakening it in F. However, since for H firms the domestic market is the more lucrative and also the larger, the increase in domestic competition dominates the decrease in foreign competition. Things are different in the case of $r_F(\gamma)$. Since for F firms the domestic market is still the more lucrative but also the smaller, the increase in domestic competition always dominates the decrease in foreign competition only if the domestic market is large enough (σ is small enough). When this is not the case, $r_F(\gamma)$ has a minimum at $\gamma = 2\phi[a(2\sigma - 1) - \sigma b\tau]/(cK\tau) > 0$. This implies that, when σ is large, $r_F(\gamma)$ is first decreasing and then increasing in γ.

We are now ready to determine the equilibrium location of firms as the outcome of the international allocation of capital. Since it is capital flows that determine the location of firms, an equilibrium arises when no capital owner can earn strictly higher returns by changing the country serviced by her capital endowment. This happens for $0 < \gamma < 1$ whenever capital returns are equalized in the two countries:

$$r_H(\gamma) = r_F(\gamma) \tag{16}$$

and for $\gamma = 1$ $[\gamma = 0]$ whenever $r_H(1) \geq r_F(1)$ $[r_F(0) \geq r_H(0)]$.[4] In these latter cases the modern sector is clustered in one country only, with the other country completely specialized in the production of the traditional good.

[4]Since $r_H(\gamma)$ is decreasing while $r_F(\gamma)$ is increasing in γ, if they cross, they do so only once.

Plugging (14) as well as the corresponding expression for country F in (16) and solving for γ, we obtain the equilibrium location of firms:

$$\gamma^M = \frac{1}{2} + \frac{\phi(2a - \tau b)(2\sigma - 1)}{\tau c K} \tag{17}$$

Given $\sigma > 1/2$ and the trade condition (10) that implies $(2a - \tau b) > 0$, γ^M is always larger than $1/2$. It is also less than 1 in so far as τ is larger than

$$\tau^M_{cluster} \equiv \frac{4a\phi(2\sigma - 1)}{2b\phi(2\sigma - 1) + cK} \tag{18}$$

when τ falls short of this threshold the modern sector is clustered inside country H and country F is completely specialized in the production of the traditional good. Therefore, the incomplete specialization of F is compatible with intraindustry trade flows only if $\tau_{trade} > \tau^M_{cluster}$ i.e.

$$\sigma < \frac{1}{2} + \frac{cK}{4(b\phi + cK)} \tag{19}$$

which shows that the modern sector is more likely to cluster the larger country H (larger σ), the lower the substitutability of varieties (lower c), the higher the degree of returns to scale (larger ϕ). When (19) is violated trade always leads to complete specialization of F in the production of the traditional good. For example, this is always the case with asymmetric countries ($\sigma > 1/2$) when firms are monopolists ($c = 0$).

Proposition 1 *When trade barriers are zero, the equilibrium location of firms and capital is indeterminate.*

When trade barriers are positive, two alternative scenarios arise:

(i) if $0 < \tau < \tau^M_{cluster}$ all firms agglomerate in the larger country ($\gamma^M = 1$);

(ii) if $\tau^M_{cluster} < \tau < \tau_{trade}$, while some firms are located also in the smaller country, the larger country hosts a more than proportionate share of them ('home-market effect': $1/2 < \sigma < \gamma^M$).

We can evaluate capital returns for positive trade costs. When $0 < \tau < \tau^M_{cluster}$ all firms are clustered in country H. Setting $\gamma^M = 1$ in (14) yields:

$$r^M_1 \equiv r_H(1) = \frac{L(b\phi + cK)}{(2b\phi + cK)^2}[a^2\sigma + (a - \tau b)^2(1 - \sigma)] \tag{20}$$

where the equilibrium capital return r_1^M is a decreasing function of transportation costs and an increasing function of the relative size of country H.

When $\tau_{cluster}^M < \tau < \tau_{trade}$, the equilibrium return to capital can be found by substituting (17) into (14):

$$r^M = \frac{L(b\phi + cK)[16\phi^2(2a - \tau b)^2\sigma(1-\sigma) + \tau^2(2b\phi + cK)^2]}{16\phi^2(2b\phi + cK)^2} \tag{21}$$

Expression (21) is a concave function of σ with a maximum at $\sigma = 1/2$, which shows that the smaller the size differential between countries is, the higher the remuneration of capital becomes. The reason is weaker spatial competition. Indeed, (17) shows that, as σ tends towards 1/2, also γ gets closer to that value. Then, (11) reveals that at $\gamma = 1/2$ freight absorption reaches its minimum ($p_{HF} - p_{HH} = \tau/2$), which is what a monopolist would deliver when facing a linear demand. Moreover, (21) is a convex function of τ with a minimum at some $\tau \in [0, \tau_{trade}]$. The reason is that higher trade costs relax spatial competition but also increase freight absorption. Thus, reducing trade costs from an already low level increases capital return because the positive effect of less freight to be absorbed dominates the negative effect of tougher competition. The opposite is true starting from a high τ.

4 Efficient location

Pricing above marginal costs is the single distortion in the model. This has no implication for product diversity. Indeed, since N is determined by the capital endowment K and the technology parameter ϕ (see (12) and (13)), the free market outcome delivers optimum product diversity. Nevertheless, mark-up pricing generates two efficiency losses. The first is standard: for a given distribution of firms γ market power causes a deadweight loss in terms of foregone consumption. The second arises because firms are mobile: a firm's relative operating profits do not capture the full effects of relocation on consumer surpluses and other firms' operating profits. The reason is freight absoption that biases the relative prices of domestic and imported varieties in favor of the latter. Therefore, at the market equilibrium there is too much trade going on.

To derive a useful benchmark for tax competition, which usually is takes the pricing policies of firms as given, in the present welfare analysis we consider the choice of a *second-best planner* who is able to assign any number of modern firms to a specific region but is unable to use lump-sum transfers from workers to firms to implement marginal cost pricing. In this case, the planner chooses γ in order to maximize the sum of all consumers' indirect utilities, wherever they reside, evaluated at market prices (6)-(9):

$$\begin{aligned} W(\gamma) = & S_H(\gamma)\,\sigma L + S_F(\gamma)\,(1-\sigma)L \\ & + r_H(\gamma)\,\gamma K + r_F(\gamma)\,(1-\gamma)K + \text{constant} \end{aligned} \tag{22}$$

Where $S_H(\gamma)$ and $S_F(\gamma)$ are individual consumer surpluses in the two countries associated with the equilibrium prices (6) and (9). Specifically, by (1) we have:

$$\begin{aligned} S_H(\gamma) = & \frac{a^2 K}{2b\phi} - \frac{aK}{\phi}\left[\gamma\, p_{HH} + (1-\gamma)\, p_{FH}\right] \\ & + \frac{K(b\phi + cK)}{2\phi^2}\left[\gamma\, p_{HH}^2 + (1-\gamma)\, p_{FH}^2\right] \\ & - \frac{cK^2}{2\phi^2}\left[\gamma\, p_{HH} + (1-\gamma)\, p_{FH}\right]^2 \end{aligned} \tag{23}$$

This expression can be shown to be quadratic in γ. In particular, differentiating it twice with respect to γ reveals that $S_H(\gamma)$ is concave. Furthermore, (10) implies that $S_H(\gamma)$ is always increasing in γ over the interval $[0,1]$. Hence, as more firms enter in H, the surplus of residents rises because local prices fall. However, this effect gets weaker and weaker as the number of local firms increases. A symmetric expression holds for consumer surplus in the foreign country.

Solving the first order condition yields the second-best spatial distribution of modern firms:

$$\gamma^S \equiv \gamma^M - \frac{\phi(2a - \tau b)(2b\phi + cK)(2\sigma - 1)}{\tau c K(8b\phi + 3cK)} \tag{24}$$

where the ratio on the right hand side is positive by (10). It can be easily checked that $\gamma^S > \sigma$. Thus, we have $\sigma < \gamma^S < \gamma^M$ which implies that the market outcome leads to too much concentration with respect to the second-best allocation. Equation (24) also shows that the discrepancy between γ^M and γ^S grow as τ falls: *economic integration widens the gap between market and efficient outcomes.*

Moreover, when trade costs are low enough, also the planner would like to have all firms in the larger region. This is indeed the case whenever τ falls below the following threshold:

$$\tau^S_{cluster} \equiv \frac{8a\phi(3b\phi + cK)(2\sigma - 1)}{12b^2\phi^2(2\sigma - 1) + cK[4b\phi(2\sigma + 1) + 3cK]} \tag{25}$$

which is smaller than $\tau^M_{cluster}$, implying that there is an interval of trade costs ($\tau^S_{cluster} < \tau < \tau^M_{cluster}$) such that all firms cluster in H at the market outcome while they should not from a second-best perspective.

These results can be summarized as follows:

Proposition 2 *When trade barriers are zero, the optimal location of firms and capital is indeterminate.*

When trade barriers are positive, two alternative scenarios arise:

(i) if $0 < \tau < \tau^S_{cluster}$ *it is optimal to have all firms agglomerated in the larger country* ($\gamma^M = 1$)*.*

(ii) if $\tau^S_{cluster} < \tau < \tau_{trade}$*, while some firms are located also in the smaller country, it is optimal for the larger country to host a more than proportionate share of them ('home-market effect':* $1/2 < \sigma < \gamma^S$*).*

Moreover:

Proposition 3 *The efficiency properties of the market outcome differ depending on the level of trade costs. In particular:*

(i) if $0 < \tau < \tau^S_{cluster}$ *the market outcome and the optimum coincide;*

(ii) if $\tau^S_{cluster} < \tau < \tau^M_{cluster}$ *the market outcome yields complete clustering of firms in the larger country while the optimum has some firms also in the smaller country;*

(iii) if $\tau^M_{cluster} < \tau < \tau_{trade}$*, while both the market outcome and the optimum yield a more than proportionate presence of firms in the larger country, the share of firms in the larger country is smaller at the optimum than at the market outcome.*

In particular, when $\tau^M_{cluster} < \tau < \tau_{trade}$, the welfare loss evaluates to:

$$W(\gamma^S) - W(\gamma^M) = \frac{(2\sigma - 1)^2(2a - \tau b)^2(b\phi + cK)L}{8c(8b\phi + 3cK)} \tag{26}$$

which increases as the level of trade costs falls. In other words, as long as firms are not completely clustered, *economic integration increases the welfare loss due to the inefficient spatial distribution of firms at the market outcome.*

5 Tax competition

In this section we investigate the effects of tax competition on the location of firms. In so doing we adopt a simple tax competition game. In particular, we assume that (i) country choices are made by two national planners (*governments*); (ii) each national planner maximizes the welfare of its own citizens; (iii) source-based per-unit taxes on labor and capital are the only available policy tools;[5] (iv) each government faces an exogenously determined budget requirement;[6] (v) taxation is not discriminatory (i.e., tax rates are the same for domestic and foreign capital). The game between the two governments takes place in two stages. In the first, governments simultaneously choose their countries' welfare maximizing tax rates. In the second, firms and consumers make their choices taking the chosen tax rates as given. The equilibrium concept adopted will be subgame-perfect Nash with two players in the first stage and a continuum of players in the second.

A. Second-stage game: firms and consumers

Let us solve the game backwards and call t_i and t_i^L, respectively, the *per unit* capital and labor tax rates in country i ($i = H, F$). In the second stage, firms and consumers make their decisions taking fiscal choices as given. In country H, equilibrium prices are again given by (6) and (9) and the equilibrium return to capital by (14). Analogous expressions hold for F. What changes is the equilibrium location of firms because now an equilibrium arises when no capital owner can earn strictly higher *after-tax* returns by changing the country serviced by her capital endowment. This happens for $0 < \gamma < 1$ whenever after-tax capital returns are equalized in the two countries :

$$r_H(\gamma) - t_H = r_F(\gamma) - t_F \tag{27}$$

and for $\gamma = 1$ [$\gamma = 0$] whenever $r_H(1) - t_H \geq r_F(1) - t_F$ [$r_F(0) - t_F \geq r_H(0) - t_H$].

[5] What we have in mind is corporate taxation, which is generally based on the the 'source principle': income is taxed where generated, that is, where firms are located. As we will see, in our model the source-based capital tax is used as a strategic device to influence the international location of firms. Alternatively taxation could take place under the 'residence principle': income is taxed where capital owners reside. However, taxation under the residence principle would not affect the location of firms.

[6] This assumption (iv) enables us to abstract from the issue of public good provision (Kehoe, 1989).

To deal with these three alternative cases, we start solving the game assuming that the interior constraints on the equilibrium γ are satisfied. Then we establish under which conditions such constraints are indeed satisfied by the solutions. Finally we characterize the equilibrium outcome when those conditions are not met.

Assuming an interior outcome ($0 < \gamma < 1$), the solution of (27) in terms of γ yields its equilibrium value as a function of the tax differential:

$$\gamma(t_H, t_F) \equiv \gamma^M - 2\frac{t_H - t_F}{\tau^2}\frac{\phi^2(2b\phi + cK)}{cKL(b\phi + cK)} \tag{28}$$

which shows that a higher tax rate in one country discourages firms location:

$$\gamma_{t_H}(t_H, t_F) = -\gamma_{t_F}(t_H, t_F) = -\frac{2\phi^2(2b\phi + cK)}{\tau^2 cKL(b\phi + cK)} < 0 \tag{29}$$

where the lower index on γ's denotes the partial derivative with respect to the corresponding argument, e.g. $\gamma_{t_H}(t_H, t_F) \equiv \partial\gamma(t_H, t_F)/\partial t_H$. **Expression (29) also points out that the discouraging location effect of a higher tax rate gets stronger as trade costs fall. Thus, *trade integration makes capital more responsive to tax differences*: as trade barriers vanish all that matter for location choices is the tax differential.**

To proceed it is useful to define $\rho(t_H, t_F)$ as the common after-tax return that accrues to all units of capital in equilibrium. That implies $\rho(t_H, t_F) \equiv r_H(\gamma) - t_H = r_F(\gamma) - t_F$. Substituting (28) into (14) gives then:

$$\rho(t_H, t_F) \equiv r^M - \frac{t_H + t_F}{2} + \frac{\phi^2(t_H - t_F)^2}{\tau^2 L(b\phi + cK)} \tag{30}$$

which shows that a higher average tax rate and a lower tax wedge both reduce after-tax return on capital. Specifically, the marginal effect on capital return of an increase in tax rates is:

$$\rho_{t_H}(t_H, t_F) = -\frac{1}{2} + \frac{2(t_H - t_F)\phi^2}{\tau^2 L(b\phi + cK)}, \quad \rho_{t_F}(t_H, t_F) = -\frac{1}{2} - \frac{2(t_H - t_F)\phi^2}{\tau^2 L(b\phi + cK)} \tag{31}$$

Accordingly, an increase in the tax rate of the low-tax country unambiguosly reduces the common after-tax capital return. The reason is both an increase in the average tax rate and the reduction in tax arbitrage opportunities for capital owners as the tax wedge shrinks. Differently, when the high-tax country raises its rate, the impact on the after-tax return is ambiguous. This is explained by the fact that the higher average tax rate is now accompanied by increased arbitrage opportunities as the tax wedge expands. However, comparing (31) with (28) shows that the average-tax effect always dominates the tax-arbitrage effect except for large tax differentials that are compatible with $0 < \gamma < 1$ in the extreme case in which the higher tax country hosts very few firms while being relatively large. Finally, the arbitrage effect gets stronger as trade barriers fall since firms' location choices are increasingly dominated by tax considerations.

B. First-stage game: governments

Turning to the first stage, governments simultaneously choose their tax rates anticipating the impact of their choices on the second-stage decisions of firms and consumers. In each country i, taxation on capital and labor is chosen as to raise a given amount of revenues, G_i. Without loss of generality we shall assume that the budget is balanced, $G_i = 0$. Since we assume that capital taxes are levied according to the source principle, all capital invested in a certain country is subject to the same tax rate. Thus, the governments' budget constraints are given by:

$$0 = t_H \gamma K + t_H^L \sigma L \text{ and } 0 = t_F(1-\gamma)K + t_F^L(1-\sigma)L \tag{32}$$

Notice that, since the budget has to be balanced, the policy problem faced by the government is one-dimensional: the choice of the tax rate on capital automatically determines the tax rate on labor required to satisfy the budget constraint. Moreover, as labor is immobile and in inelastic supply, the tax on labor is essentially lump-sum.[7]

Using (32) to substitute the labor tax, welfare in country H equals:

$$W_H = S_H(\gamma)\,\sigma L + \sigma L + \gamma r^H(\gamma)K - (\gamma - \sigma)\rho K \tag{33}$$

where the dependence of γ and ρ on capital tax rates has been left implicit to simplify notation. In (33) $S_H(\gamma)$ is individual consumer surplus defined by (23), σL is labor income, $\gamma r^H(\gamma)K$ is the gross income from the modern sector and $(\gamma - \sigma)\rho K$ is the net contribution from abroad. Notice that, as

[7]Our results would not change if we introduced a public good and a preliminary stage of the game in which governments decide on the level of its provision. The public good would be provided efficiently because of the lump-sum nature of labor taxation.

long as $\gamma > \sigma$, the country is importing capital, which means that there is a positive net contribution from abroad and part of the tax burden is borne by foreign residents.

Given t_j, the first order condition (best reply) of government i requires then $dW_i/dt_i = 0$. For government H we have:

$$\frac{dW_H}{dt_H} = \frac{dW_H}{d\gamma}\gamma_{t_H} + \frac{dW_H}{d\rho}\rho_{t_H} \tag{34}$$
$$= \left[\frac{dS_H(\gamma)}{d\gamma}\sigma L + \gamma\frac{dr^H(\gamma)}{d\gamma} + tK\right]\gamma_{t_H} - (\gamma - \sigma)K\rho_{t_H}$$

where γ_{t_H} is given by (29), ρ_{t_H} by (31), and:

$$\frac{dS_H(\gamma)}{d\gamma} = \frac{\tau(b\phi + cK)\{4\phi(2a - b\tau)(b\phi + cK) - \tau c^2K^2(2\gamma - 1)]\}K}{8\phi^2(2b\phi + cK)^2}$$

**Expression (34) reveals the traditional 'capital-movement' and 'terms-of-trade' effects of capital taxation. The national welfare is affected by capital taxation because it induces international capital movements (viz. $(dW_H/d\gamma)\gamma_{t_H}$) and because it influences the terms at which capital is internationally traded (viz. $(dW_H/d\rho)\rho_{t_H}$). The terms of trade effect appears in most of the traditional literature on corporate tax competition (see. e.g., Wilson, 1999). As argued above, the effect of capital taxation on ρ is unambiguously negative except in the case of a higher-tax country that hosts very few firms while being relatively large. Therefore, except in this extreme case, a capital importing country is willing to tax capital in order to decrease the resources spent in importing it. The opposite is true for the capital exporting country.

The capital-movement effect is richer than in the traditional models since capital flows affect national welfare through three different channels. First, capital flows generate an international externality because the social value of capital $r^H(\gamma)$ differs from its social cost ρ by the level of the capital tax. This externality, whose intensity increases with the tax rate, fully accounts for the traditional capital-movement effect (see, e.g., Bucovetsky (1991) and Wilson (1991)). The two remaining channels are peculiar to our model. On the one side, an outflow of capital influences negatively the surplus of domestic consumers, who have to increase their reliance on imports in the modern sector and thus have to face additional trade costs. On the other, a loss of capital decreases competition on the domestic market and therefore increases the local operating profits of modern firms. Therefore, an increase in the national tax rate decreases the domestic consumer surplus and increases domestic operating profits.[8]

Symmetric expressions hold for government F. In particular, its best reply has to satisfy $dW_F/dt_F = 0$ where:

$$\frac{dW_F}{dt_F} = \left[\frac{dS_F(\gamma)}{d\gamma}(1-\sigma)L + (1-\gamma)\frac{dr^F(\gamma)}{d\gamma} - t^F K\right]\gamma_{t_F} - (\sigma-\gamma)K\rho_{t_F} \tag{35}$$

with:

$$\frac{dS_F(\gamma)}{d\gamma} = \frac{\tau(b\phi+cK)\{4\phi(2a-b\tau)(b\phi+cK)+\tau c^2K^2(2\gamma-1)]\}K}{8\phi^2(2b\phi+cK)^2},$$

$$\rho_{t_F}(t_H,t_F) = \frac{2(t_F-t_H)\phi^2}{\tau^2L(b\phi+cK)} - \frac{1}{2} \text{ and } \gamma_{t_F}(t_H,t_F) = -\gamma_{t_H}(t_H,t_F)$$

As to second order conditions, it can be verified that both W_H and W_F are concave functions of t_H and t_F respectively.

C. Tax rates and firms location

Solving (34) and (35) for t_H and t_F gives the subgame-perfect Nash equilibrium tax rates. We have to distinguish between two scenarios depending on whether τ is larger or smaller than $\tau^M_{cluster}$. In the former case, the equilibrium tax rates are:

$$t_H = -\tau[\Theta_0(\Theta_0'-\tau) - \Theta_1(\Theta_1'-\tau)(2\sigma-1)^2 - \Theta_2(\Theta_2'-\tau)(2\sigma-1)] \tag{36}$$

and:

$$t_F = -\tau[\Theta_0(\Theta_0'-\tau) - \Theta_1(\Theta_1'-\tau)(2\sigma-1)^2 + \Theta_2(\Theta_2'-\tau)(2\sigma-1)] \tag{37}$$

where Θ_i and Θ_i', $i = 0, 1, 2$, are positive bundling parameters that do not include either σ or τ. In particular, $\Theta_i' > \tau$ when (10) holds. Under the same

[8] Essentially, in our model capital flows are manipulated to affect the location of imperfectly competitive firms. This makes it different from the classical set-up à la Ramaswani (1968) in which factor flows are manipulated to affect relative factor endowments.

condition, it can be shown that (36) and (37) are always negative for positive τ, being convex functions of trade costs. Therefore, *tax competition leads to subsidies to capital funded through taxes on labor.* Moreover, (36) and (37) are monotonous functions of σ. However, while the former is increasing, the latter is decreasing in σ.

All this is reflected by the tax differential:

$$t_H - t_F = \frac{\tau L(2\sigma - 1)(b\phi + cK)[6a\phi - \tau(3b\phi + cK)]}{2\phi^2(12b\phi + 5cK)} > 0 \qquad (38)$$

which shows that the equilibrium tax wedge is concave and increasing in the level of trade costs for every $\tau < \tau_{trade}$ so that *trade integration induces a convergence of international tax rates.* Indeed, when integration is complete ($\tau = 0$) tax rates are identical ($t_H = t_F = 0$). Furthermore, the equilibrium tax wedge is also increasing in relative size σ: were countries of equal size, there would be no tax wedge ($t_H = t_F = 0$).[9]

Substituting (38) into (28), we obtain the equilibrium location of firms under tax competition:

$$\gamma^T = \gamma^M - \frac{(2\sigma - 1)(2b\phi + cK)[6a\phi - \tau(3b\phi + cK)]}{\tau cK(12b\phi + 5cK)} \qquad (39)$$

Condition (10) ensures that $\sigma < \gamma^T < \gamma^M$ so that tax competition induces the larger country to subsidize less, thus reducing its share of firms with respect to the free market outcome. This is the more so the larger τ because of the smaller responsiveness of firms location to tax differentials **(see (28))**.[10]

In addition, the threshold value for τ below which firms are all concentrated in the larger country H is now lower than $\tau^M_{cluster}$, the exact value being:

$$\tau^T_{cluster} \equiv \frac{8a\phi(2\sigma - 1)(3b\phi + cK)}{12b\phi[b\phi(2\sigma - 1) + cK] + (7 - 4\sigma)c^2K^2} \qquad (40)$$

These results can be summarized in the following proposition:

Proposition 4 *Assume capital-income tax competition and* $\tau^T_{cluster} < \tau < \tau_{trade}$*. Then, in equilibrium :*

[9] See Janeba (1998) as well as Ludema and Wooton (2000) for a similar result.
[10] This result is reminiscent of Haufler and Wooton (1999).

(i) if countries are equal-sized ($\sigma = 1/2$), governments do not intervene ($t_H = t_F = 0$) and the location of firms is the free-market one ($\gamma^T = \gamma^M$);

(ii) if countries are different sized ($\sigma > 1/2$), both government subsidize capital income but subsidies are higher in the smaller country ($t_F < t_H < 0$). Moreover, the larger country hosts a more than proportionate share of firms ($\sigma < \gamma^T$).

D. Taxing a cluster

The above results differ from the existing literature on clusters (see, e.g., Kind at al., 2000) in that they characterize the tax competitive outcome when agglomeration is not complete, which is the case for $\tau^T_{cluster} < \tau < \tau_{trade}$. To make our analysis fully comparable with previous research, it is nonetheless useful to characterize the equilibrium of the model when all firms end up clustering in one country. As discussed above, this happens when trade costs are low enough ($\tau < \tau^T_{cluster}$) and all firms are located in country H. Indeed, in that case we have just shown that there exists no equilibrium of the tax game such that capital is invested in both countries.

When $\tau < \tau^T_{cluster}$, we have $\gamma^T = 1$ implying net capital return $\rho(t_H, t_F) = r^M_1 - t_H$. Consequently, $\gamma_{t_H} = \gamma_{t_F} = \rho_{t_F} = 0$ and $\rho_{t_H} = -1$, which give:

$$\frac{dW_H}{dt_H} = (1-\sigma)K > 0 \text{ and } \frac{dW_F}{dt_F} = 0 \tag{41}$$

Conditions (41) show that the government in H sets its tax rate at the highest level compatible with government F being unable to affect the location of firms. This means that in equilibrium government H chooses a tax rate such that $r_H - t_H = r_F - t_F$ just holds at $\gamma = 1$ for given t_F:

$$t_H - t_F = \frac{\tau L(b\phi + cK)\{4a\phi(2\sigma - 1) - \tau[2b\phi(2\sigma - 1) + cK]\}}{4\phi^2(2b\phi + cK)} \tag{42}$$

Thus, the tax wedge is positive for $0 < \tau < \tau^M_{cluster}$, is concave in τ and reaches a maximum at $\tau^M_{cluster}/2$. This is due to the fact that the tax wedge captures the location rents of clustered firms and such rents are hump-shaped (Baldwin et al., 2002).

Moreover, the equilibrium tax rates have also to be such that at $\gamma = 1$ government F has no incentive to decrease t_F (which would attract some capital to F) and the government H has not incentive to raise t_H (which would repel some capital from H):

$$\left.\frac{dW^H}{dt^H}\right|_{\gamma=1} < 0 \text{ and } \left.\frac{dW^F}{dt^F}\right|_{\gamma=1} > 0 \tag{43}$$

These two conditions identify a segment along the line (42) which is upward sloping in the (t_H, t_F)-plane. Since the second-order conditions of the first-stage tax game are satisfied, it must be that $dW^H/dt^H < 0$ when t^H is large enough and $dW^F/dt^F > 0$ when t^F is small enough. This means that along (42), there exist $\underline{t}^F$ such that $dW^H/dt^H\big|_{\gamma=1} < 0$ when $t^F > \underline{t}^F$, and $\bar{t}_F$ such that $dW^F/dt^F\big|_{\gamma=1} > 0$ when $t^F < \bar{t}^F$. In particular, it can be shown that $\underline{t}^F < \bar{t}_F$ so that, when $\tau < \tau^T_{cluster}$, a continuum of equilibrium tax rates exists such that $t_F \in [\underline{t}_F, \bar{t}_F]$ and, for any given t_F in that interval, t_H satisfies (42). For low values of τ, both $\underline{t}_F$ and $\bar{t}_F$ are decreasing functions of τ, which means that, once trade costs are low enough, further reductions in such costs decrease the tax differential (see (42)) but increase the tax levels. These results are consistent with those in Kind, Midelfart-Knarvik and Schjelderup (2000).

To sum up:

Proposition 5 *Assume capital-income tax competition and* $0 < \tau < \tau^T_{cluster}$. *Then in equilibrium:*

(i) if countries are equal-sized ($\sigma = 1/2$)*, governments do not intervene* ($t_H = t_F = 0$) *and the location of firms is the free-market one* ($\gamma^T = \gamma^M$)*;*

(ii) if countries are different-sized ($\sigma > 1/2$)*, all firms cluster in the larger country* ($\gamma^T = 1$) *and the larger country sets its tax rate at the highest level compatible with the smaller country being unable to affect the location of firms. In particular, there exists a continuum of tax rates and these satisfy (42) and (43).*

6 Coordination needed

This section studies the welfare implications of tax competition. Straightforward calculations reveal that, when (10) holds, we have:

$$\sigma < \gamma^T < \gamma^S < \gamma^M \tag{44}$$

and

$$\tau^T_{cluster} < \tau^S_{cluster} < \tau^M_{cluster} \tag{45}$$

These results are summarized in Figure 1 and show that, when firms are not clustered in the larger region, under tax competition their international distribution is more balanced than at the free market outcome, but too much so from a welfare point of view. Moreover, there is an interval of trade costs between $\tau^T_{cluster}$ and $\tau^S_{cluster}$ in which firms are not clustered under tax competition while they are at both the free market and optimal allocations. In other words, *tax competition acts as a dispersion force, but its dispersing strength is too strong to yield an efficient spatial distribution of firms.*

The welfare loss due to tax competition is then:

$$W(\gamma^S) - W(\gamma^T) = \frac{L(2\sigma-1)^2(b\phi+cK)[8a\phi(3b\phi+cK)-3\tau(2b\phi+cK)^2]^2}{8c\phi^2(8b\phi+3cK)(12b\phi+5cK)^2} \tag{46}$$

which is positive, increasing in the size asymmetry between countries (σ), and decreasing in trade costs (τ).

Such loss is nonetheless smaller than (26). Indeed, we have:

$$W(\gamma^T) - W(\gamma^M) = LK(2\sigma-1)^2(b\phi+cK) \cdot \frac{[2a\phi+\tau(7b\phi+3cK)][6a\phi-\tau(3b\phi+cK)]}{8\phi^2(12b\phi+5cK)^2} \tag{47}$$

which is positive given condition (10). This implies that, even if suboptimal, tax competition is nonetheless welfare improving with respect to the free market outcome and therefore also with respect to tax harmonization ($t_H = t_F$). Such improvement is larger the larger the size asymmetry between countries σ.

Things are different when complete clustering occurs. Indeed, for $\tau^T_{cluster} < \tau < \tau^S_{cluster}$ the free market outcome yields efficient clustering of firms while tax competition provides an inefficient presence of firms also in the smaller country.

To summarize:

Proposition 6 *The efficiency properties of the tax-competitive outcome differ depending on the level of trade costs. In particular:*

(i) if $0 < \tau < \tau^T_{cluster}$ *the tax-competitive outcome and the optimum coincide;*

(ii) if $\tau^T_{cluster} < \tau < \tau^S_{cluster}$ *the optimum yields complete clustering of firms in the larger country while the tax-competitive outcome has some firms also in the smaller country;*

(iii) if $\tau^S_{cluster} < \tau < \tau_{trade}$*, while both the tax-competitive outcome and the optimum yield a more than proportionate presence of firms in the larger country, the share of firms in the larger country is smaller at the tax-competitive outcome than at the optimum.*

Moreover:

Proposition 7 *The efficiency properties of the tax-competitive outcome with respect to the free market one differ depending on the level of trade costs. In particular:*

(i) if $0 < \tau < \tau^T_{cluster}$ *the tax-competitive and the free-market outcomes coincide;*

(ii) if $\tau^T_{cluster} < \tau < \tau^S_{cluster}$ *the free market outcome dominates the tax-competitive one;*

(iii) if $\tau^S_{cluster} < \tau < \tau_{trade}$ *the tax-competitive outcome dominates the free market one.*

**The remaining question is whether it is possible to improve upon the tax competition outcome via fiscal coordination. If countries collude, tax rates are set to maximize overall welfare $W_H + W_F$. Differentiating (22) and using (34) as well as (35) in the resulting expression yields:

$$\frac{dW}{dt_H} = -\frac{dW}{dt_F} = \frac{dW_H}{dt_H} - \frac{dW_F}{dt_F} + (\gamma - \sigma)(\rho_{t_F} - \rho_{t_H}) \tag{48}$$

Since dW/dt_H and dW/dt_F are colinear, what matters for overall welfare maximization is the tax wedge and not the absolute levels of taxation. In particular, setting (48) to zero gives the coordinated tax differential:

$$t_H - t_F = \frac{\tau L(2a - \tau b)(b\phi + cK)(2\sigma - 1)}{2\phi(8b\phi + 3cK)} \tag{49}$$

which is positive and smaller than (38) provided (10) holds. Obviously, coordination implements the tax wedge that sustains the optimum, i.e. such that

$r_H(\gamma^S) - t_H = r_F(\gamma^S) - t_F$. This wedge is increasing in the level of trade costs (τ) and in the size asymmetry between countries (σ). Therefore, *trade integration reduces the tax differential required to achieve the efficient allocation.* The more so the smaller the size asymmetry. It is worthwhile pointing out that tax coordination on efficient taxation makes tax rates converge. Nevertheless, it does not lead to full convergence ('tax harmonization') as different tax rates are needed to correct the free market tendency to over-concentrate capital in the larger country.

After showing that coordination (but not harmonization) improves overall welfare, a natural question to ask is whether it improves the welfare of both countries. Since the coordinated outcome is a tax wedge, there is a degree of freedom left. Increasing the level of capital taxation while keeping the tax differential at (49) allows governments to transfer resources from the capital exporting country to the capital importing one. In other words, the choice of the level of capital taxation can be used as an indirect side payment mechanism in order to make coordination not only efficient but also Pareto-improving (Peralta and van Ypersele, 2002).

Finally, equation (48) can be used to gauge the reason why tax competition leads to an inefficient outcome. We have seen that at the non-cooperative equilibrium taxes are set such that $dW_H/dt_H = dW_F/dt_F = 0$. Together with (31), this implies that at the tax competitive equilibrium (48) becomes $dW/dt_H = -dW/dt_F = -4(\gamma^T - \sigma)(t_H - t_F)\phi^2/[\tau^2 L(b\phi + cK] < 0$. Accordingly, we have $dW/dt_H < 0$ and $dW/dt_F > 0$ so that under tax competition the tax rate is inefficiently high in the larger home country and inefficiently low in the smaller foreign one. The reason is the presence of a 'fiscal externality'. Due to the home market effect, the tax base in the larger country consists of all its own capital plus some foreign capital. On the contrary, the tax base in the foreign country includes only a fraction of its own capital and no alien capital. Therefore, there exists a negative externality from the larger country to the smaller one and a positive externality viceversa. In addition, since these externalities gain strength as trade gets freer, deeper integration gives the home country stronger incentives to over-tax and the foreign country stronger incentives to under-tax.**

7 Conclusion

Economic integration usually dismantles barriers to goods and factors mobility while allowing governments to function independently in most policy areas. This raises the natural issue whether such independence is good or not. We have tackled such issue from the angle of tax competition for mobile capital by asking three related questions. Does tax competition yield an inefficient international specialization in production? Does it yield inefficient shipments of goods across countries? If such inefficiencies exist, are they related to the extent of trade integration?

**The existing literature identifies the basic requirements that a model must satisfy in order to tackle those questions: international externalities, different country sizes, imperfect competition, and trade costs. Nonetheless it does not provide any model that fulfills all those requirements while proposing at the same time a full-fledged global welfare analysis. We have developed one such model featuring tax competition for mobile firms in a monopolistically competitive sector. In our model, when trade costs are large enough to make it inefficient for all firms to cluster in a single country, tax competition for mobile firms is efficiency-enhancing with respect to the free market outcome. Nonetheless, while the latter entails too many firms in the larger country, the former has too many firms in the smaller one. Accordingly, as trade costs fall and clustering becomes efficient, tax competition becomes efficiency-reducing with respect to the free market outcome. Finally, under both scenarios the resulting inefficiencies in international specialization and trade flows vanish when trade costs are low enough. Otherwise, only international tax coordination can implement the efficient spatial distribution of firms.

All this leads us to conclude that the policy attitude towards tax competition should depend on the degree of trade integration. In particular, our model suggests that, at the inital stages of an integration process, forbidding tax competition without agreeing on tax coordination is a bad idea. It is much less so at later stages, when the free market and the harmonization outcomes tend to coincide. This might explain why, for example, in the history of both the EU and NAFTA, the issue of tax competition has been gaining attention as integration proceeded.**

References

[1] Anderson F. and R. Forslid (1999) Tax competition and economic geography, CEPR Discussion Paper n. 2220.

[2] Baldwin R. and P. Krugman (2000) Agglomeration, integration and tax harmonization, CEPR Discussion Paper n. 2630.

[3] Baldwin R., R. Forslid, P. Martin, G. Ottaviano and F. Robert-Nicoud (2002) Public Policies and Spatial Economics (Princeton: Princeton University Press), forthcoming..

[4] Black D. and W. Hoyt (1989) Bidding for firms, *American Economic Review* 79, 1249-1256.

[5] Brander, J.A. and P.R. Krugman (1983) A 'reciprocal dumping' model of international trade, *Journal of International Economics* 15, 313-323.

[6] Bucovetsky S. (1991) Asymmetric tax competition, *Journal of Urban Economics* 30, 167-181.

[7] Edwards J. and M. Keen (1996) Tax competition and Leviathan, *European Economic Review* 40, 113-134.

[8] Head K and T. Mayer (2000).Non-Europe. The magnitude and causes of market fragmentation in the EU, *Weltwirtschaftliches Archiv* 136, 285-314.

[9] Haufler, A. and I. Wooton (1999) Country size and tax competition for foreign direct investment, *Journal of Public Economics* 71, 121-139.

[10] Helpman E. and P. Krugman (1985) *Market Structure and Foreign Trade* (Cambridge MA: MIT Press).

[11] Janeba E. (1998) Tax competition in imperfectly competitive markets, *Journal of International Economics* 44, 135-153.

[12] Kehoe, P. (1989) Policy cooperation among benevolent governments may be undesirable, *Review of Economic Studies* 56, 289-296.

[13] Kind H.J., K.H. Midelfart-Knarvik and G. Schjelderup (2000) Competing for capital in a 'lumpy' world, *Journal of Public Economics* 78, 253-274.

[14] Ludema, R.D. and I. Wooton (2000) Economic geography and the fiscal effects of regional integration, *Journal of International Economics* 52, 331-357.

[15] Mintz, J., Tulkens, H. (1996), Optimal Properties of Alternative Systems of Taxation of Foreign Capital Income, *Journal of Public Economics* 60, 373-399.

[16] Ottaviano, Tabuchi and Thisse (2002) Agglomeration and trade revisited, *International Economic Review*, forthcoming.

[17] Persson T. and G. Tabellini (1992) The politics of 1992: Fiscal policy and European integration, *Review of Economic Studies* 59, 689-701.

[18] Peralta and van Ypersele (2002) Coordination of Capital Taxation Among Asymmetric Countries, CORE Discussion Paper.

[19] Ramaswani, V. (1968) International factor movement and the national advantage, *Economica* 35, 309-310.

[20] Wilson, J. (1991) Tax competition with interregional differences in factor endowments, *Regional Science and Urban Economics* 21, 423-452.

[21] Wilson, J. (1999) Theories of tax competition, *National Tax Journal* 52, 268-304.

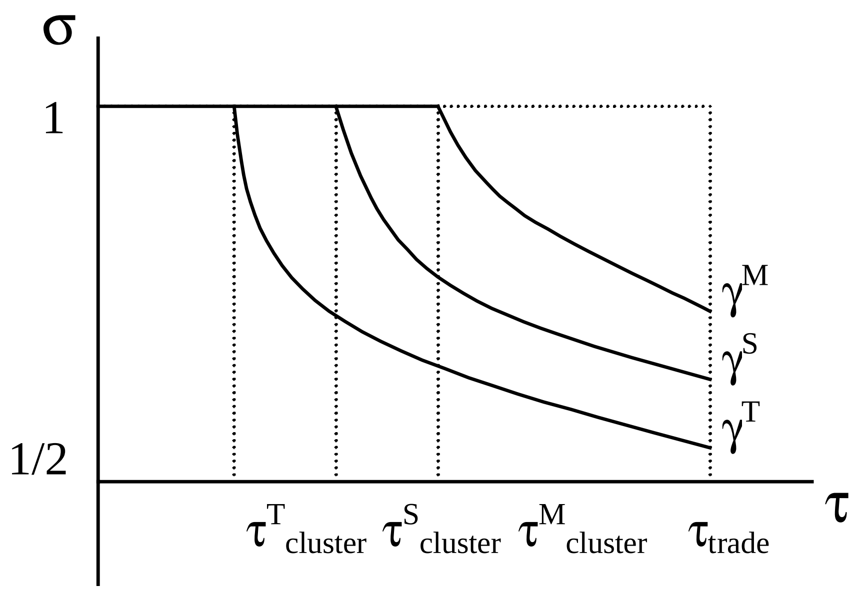

Figure 1 – Location effects of integration