Haufler, Andreas und Wooton, Ian:

Regional Tax Coordination and Foreign Direct Investment

Regional Tax Coordination and

Foreign Direct Investment[*]

Andreas Haufler[†]

University of Munich

Ian Wooton

University of Glasgow and CEPR

July 2003

Abstract

This paper analyses the effects of a regionally coordinated corporate income tax in a model with three active countries, one of which is not part of the union, and a globally mobile firm. We show that regional tax coordination can lead to two types of welfare gain. First, for investments that would take place in the union in the absence of coordination, a coordinated tax increase can transfer location rents from the firm to the union. Second, by internalising all of the union's benefits from foreign direct investment, a coordinated tax reduction can attract more welfare-enhancing investment than when member states act in isolation. Depending on which motive dominates, tax levels may thus rise or fall under regional coordination.

Keywords: tax competition, regional coordination, foreign direct investment

JEL Classification: F15, F23, H73, H87

[†] Corresponding author: Andreas Haufler, Seminar for Economic Policy, Department of Economics, University of Munich, Akademiestr. 1 / II, D-80799 Munich, Germany. Telephone: (+ 49) 89-2180-3858. Fax: (+49) 89-2180-6296. E-mail: Andreas.Haufler@lrz.uni-muenchen.de

1 Introduction

It is frequently argued that the increasing international mobility of firms is a main reason for the significant fall in corporate tax rates worldwide. The more footloose the factor, the more easily it can avoid taxation by migrating to a tax haven. Consequently, greater mobility intensifies the competition between jurisdictions in reducing taxes in order to attract corporate investment.[1] In the European Union, these developments have led to an intense debate as to whether corporate taxation should be formally coordinated between member states. In 1998 the EU council adopted a Code of Conduct for business taxation in which member states commit themselves to refrain from 'unfair' tax policies that discriminate against (less mobile) domestic firms in favour of (more mobile) multinational firms (see European Communities, 1998). It is by no means clear, however, that this measure will prove sufficient to prevent tax competition for internationally mobile firms.[2] For example, in response to the Code of Conduct, Ireland introduced in 2003 a general corporate income tax rate of 12.5 per cent, underbidding all of its EU competitors by a margin of more than 10 percentage points.[3] Moreover, with the enlargement of the EU in 2004, a number of Eastern European countries with corporate income tax rates well below the average of the current EU members will enter the internal market.

At present, there are indications that the EU will reconsider the introduction of a minimum statutory corporate tax rate, as proposed earlier in the Ruding Report (1992). A recent constitutional convention of the EU showed clear majority support for minimum EU-wide corporate tax levels (The Economist, 2002). The current decision-making processes of the EU require unanimity on tax proposals and so the minimum tax will not be adopted, given the opposition of the UK and Ireland. However, in the face of EU enlargement, majority voting will be extended to new policy areas, possibly including taxation. In this case the adoption of a minimum corporate tax rate in the EU would likely occur. An important constraint of this policy measure is, however, that EU members can only achieve a *regional*

---

[1] Statutory corporate tax rates have declined from an OECD average of almost 50 per cent in 1980 to roughly 35 percent in 2000. If effective average rates of corporation tax are considered, and account is thus taken of simultaneous changes in the corporate tax base, the reduction is somewhat less, but is nonetheless substantial. See Devereux, Griffith and Klemm (2002) for a recent account of these developments.

[2] Keen (2001) has shown that a non-discrimination policy may even be counterproductive, because it extends the range of tax bases over which countries compete.

[3] In the past, Ireland has given preferential tax treatment to multinational firms by means of a split corporate tax rate.

coordination of tax policies. Critics argue that, in response to an intra-union coordination of tax rates, firms may leave the EU altogether and settle in third countries.[4]

Despite the wealth of literature on capital tax competition and tax harmonization, and despite the obvious policy relevance of the subject, there are only few theoretical contributions that deal with regional tax coordination in a multi-country world where only a subset of countries coordinate their tax policies. In an early and influential paper, Razin and Sadka (1991) have shown that tax coordination between two (infinitely) small countries will yield no welfare gains and a zero-tax policy is optimal for the coordinating region, if cooperation with the (large) rest of the world is not feasible. However, later work has shown that a coordinated tax increase in a subgroup of countries that is able to influence the world rate of return will be welfare improving. This result holds if tax rates are strategic complements, such that countries that are not part of the agreement will find it in their own self-interest to raise domestic tax rates as well (see Konrad and Schjelderup, 1999). Similarly, in the presence of differential transaction costs for investments within the EU and in third countries, Huizinga and Nielsen (2000) show that a tax increase in an EU tax haven will increase welfare in the EU partner country, despite the presence of an outside tax haven. Finally, Sørensen (2000, 2001) carries out a set of simulation analyses in an extended, asymmetric model where countries differ from each other and distributional effects arise within each country. His calculations confirm the qualitative result that a coordinated increase in capital tax rates among the EU members will be beneficial for the union as a whole, but they also show that regional tax coordination promises only a fraction of the gains that could be achieved by worldwide tax coordination.

In sum, the existing theoretical literature argues that a regionally coordinated *increase* in the corporate tax rate is likely to bring welfare gains to a large economic union such as the EU, and therefore supports the possible policy move to establish an EU-wide corporate income tax rate. The main purpose of the present paper is to show that such a policy may well be counterproductive, in that the optimal coordinated tax policy may instead be a *reduction* in corporate income taxes.

---

[4] A recent example of global competition for FDI is that for a therapeutic protein plant to be built by a subsidiary of the US-based Merck & Co. Ltd. After being offered substantial financial support by the local government, the company has chosen a location in Germany, despite competition from other EU countries (Ireland and Spain), Switzerland, and non-European nations (Singapore, Taiwan, and the USA). See IPAWorld, 2003.

We develop this argument in a model with three active countries, one of which is outside the region, a profit-making firm that is freely mobile internationally, and a positive spillover that foreign direct investment (FDI) has on the host economy. The incentive to attract FDI arises from a desire to avoid trade costs. These are encountered in any international transaction but they are lower on trade within the union than between the union and the outside country. This fact gives a location rent to the firm if it settles in one of the union countries. The size of this rent depends on the relative trade costs for trade within and outside the union, and on the relative size of the three different markets.

The basic assumptions and mechanisms underlying this model find support in the empirical literature. First, there is a robust positive relationship between market size on the one hand, and the likelihood to attract FDI on the other (e.g. Devereux and Griffith, 1998; Head and Mayer, 2002). Moreover, there is evidence for a positive "EU dummy": controlling for other relevant characteristics of the host country, a firm will be more likely to invest in a country that is a member state of the EU, whereas a similar effect cannot be observed for members of other regional trade agreements (Grubert and Mutti, 2000). On the part of host countries, there is substantial econometric evidence that FDI is associated with positive spillovers.[5] Finally, there is by now almost unanimous consent that the corporate tax rate of the host country has a significant, negative effect on inward FDI.[6]

Our model is related to previous work on capital tax competition where positive spillovers from FDI arise from scale economies in the provision of public goods (Black and Hoyt, 1989), the existence of regional unemployment (Haaparanta, 1996), or vertical industry linkages that reduce the production costs of existing firms (Haaland and Wooton, 1999; Fumagalli, 2003). In these settings, a subsidy competition for the firm will result if the potential host countries have similar characteristics.[7] When trade costs are incorporated in this type of model, firms will have an incentive to locate in either the larger market (Haufler and Wooton, 1999) or in the country that already hosts an agglomeration (Kind et al., 2000; Baldwin and Krugman, 2003). The host country may then be able to

---

[5] See Görg and Strobl (2001) for a recent overview. At least some of the potential channels of these spillovers, such as movements of highly skilled staff from multinational corporations to domestic firms, are also effective when FDI represents a pure change in ownership, rather than a greenfield investment (Görg and Strobl, 2002).

[6] See Hines (1999) for a survey of the empirical evidence focussed on U.S. data, and de Mooij and Ederveen (2001) for a synthesis that incorporates empirical studies from the EU.

levy a positive tax on mobile firms in equilibrium, even if it benefits from the investment. All of these models consider only two competing nations, however, and none explicitly considers the issue of *regional* tax coordination.

In the analysis below we consider unilateral and regional tax policy for a union of two countries that competes with a third potential-host country for the location of a monopolistic firm. In this setting, we show that regional tax coordination may lead to two types of welfare gain. In situations where the firm's location rent in the union is large, eliminating tax competition within the union allows an *increase* in the equilibrium tax, leading to a transfer of rents from the firm to the regional governments. This corresponds to results derived in the previous literature on regional tax coordination. However, in situations where the firm has no strong preference between locating within the union or in the outside country, a coordinated *reduction* in the tax offered to the firm will be able to attract the investment and leave the union with a collective welfare gain. In this latter case, regional integration overcomes a free-riding problem when both countries in the union benefit from the investment. Our results thus imply that the direction that a regionally coordinated tax change should take, from the perspective of the union, is fundamentally ambiguous. As a corollary, we also show that a minimum corporate tax rate in the union has potentially adverse effects on union welfare.

We consider a single policy instrument, a corporate income tax that is charged on the flow of profits from the operations of the production facility in the host country. As our analysis only considers the location of a single firm from a particular industry, this policy instrument could alternatively be interpreted as an initial lump-sum subsidy offered to the firm for its investment. Against the cost of this incentive the potential host would have to weigh the expected future benefits from the investment, including the expected lifespan of the local production facility (see Haaland *et al.*, 2003). However, it will become clear that the discussion can be readily extended to the issue of attracting investment in many industries. Thus, rather than considering investment incentives for specific industries, our analysis can be applied to determining the appropriate corporate tax levels for the nations individually and for the union.

---

[7] Conversely. non-cooperative capital taxation may lead to excessively high tax rates when the location of a firm causes negative externalities for the host country, for example by polluting its environment (see Markusen *et al.*, 1995)

The analysis proceeds as follows. Section 2 presents the model, describing in turn the behaviour of households, firms, and governments. Section 3 considers the benchmark case where all countries (both those in the union and the outside country) compete to host the monopolist. Section 4 analyzes the effects of tax coordination between the two countries in the region. Section 5 discusses our results and compares them to related literature. Section 6 concludes.

2 The model

Our argument is developed in a simple partial equilibrium model. We consider tax policy in three countries $i \in \{A, B, C\}$, where countries A and B are located in the same region or union, while country C lies outside the union.[8] The three countries compete for the location of a single firm that is a monopoly supplier in the world market and has its home base outside the active countries considered in the model. Due to high plant-specific costs, the firm will set up in only one of the countries A, B, and C and serve the other markets from this base. Location matters because of trade costs (e.g., transport costs), which differ between the two countries in the union and the outside country.[9]

2.1 Households

There are two consumption goods in each country, the good produced by the monopolist (x) and a numeraire good (z) produced in a perfectly competitive market. Consumers in all countries are identical and have quadratic, quasi-linear preferences of the form

$$u_i = \alpha x_i - \frac{1}{2}\beta x_i^2 + z_i, \quad \forall i \in \{A, B, C\}. \tag{1}$$

In all countries, each household inelastically supplies one unit of labour, receiving the wage w_i. Denoting consumer prices by q_i and letting t_i/n_i be per-capita tax revenues, the budget constraint in each country is given by

$$w_i + \frac{t_i}{n_i} = z_i + q_i x_i, \quad \forall i \in \{A, B, C\}. \tag{2}$$

---

[8] In the following, we refer to countries A and B equivalently as a "region" or "union" of countries. The latter term may imply that the two countries have agreed on some form of policy coordination other than the issue under discussion here, but such pre-existing arrangements have no consequences for our analysis.

[9] This set-up extends our earlier analysis in Haufler and Wooton (1999).

In the following we assume that countries A and B are of equal size and that the population in each of these countries is normalised to unity ($n_A = n_B \equiv 1$). The population of the outside country C is $n_C \equiv n$. Thus our analysis allows for exogenous variations in the relative size of the regional market ($A + B$) vis-à-vis country C. The relevant range for n is $1 \leq n \leq 2$, i.e., country C is neither smaller than any individual country in the union, nor larger than the two union countries taken together.

Maximizing (1) subject to the budget constraint (2) and aggregating over households yields the market demand curve X_i in each country

$$X_A = \frac{\alpha - q_A}{\beta}, \quad X_B = \frac{\alpha - q_B}{\beta}, \quad X_C = \frac{n(\alpha - q_C)}{\beta}. \tag{3}$$

2.2 Firms

Labour is the only input in the production of both goods. The production function for the numeraire good (z) is the same in all countries and this good is freely traded with no trade costs. This ensures that wage costs will be equalised across countries ($w_i = w$).

In contrast, commodity x is produced by a monopolist[10] that has its home base outside of countries A, B, and C.[11] It is well known that the decision whether to export from the home base or engage in FDI will depend on the comparison between trade costs and fixed set-up cost (Horstman and Markusen, 1992). Since little can be gained from restating these conditions in the present context, we simply assume that firm-specific set-up costs are sufficiently low to make FDI profitable, and plant-specific costs are sufficiently high so that all FDI is concentrated in a single production unit. Finally, we assume that the monopolist is able to segment its market, discriminating between national markets in setting the price of good x.[12]

---

[10] The monopoly assumption is needed to keep the model tractable analytically. In the context of environmental tax competition, Rauscher (1995) introduces the same assumption in the oligopoly model of Markusen *et al.* (1995). This assumption allows Rauscher to derive analytical results without changing the qualitative implications of the model.

[11] This implies that the monopolist's profits will not enter the calculations of any of the active countries. The case where the monopolist is partly or wholly owned by residents of countries A and B is discussed in Section 5.

[12] This last modelling assumption departs from that in our discussion paper (Haufler and Wooton, 2001) where we assumed that the market for good x was integrated. The qualitative results are the same regardless of this market assumption. As the algebra is simpler under market segmentation, we have adopted it here. We are grateful to Tanguy van Ypersele for first suggesting this approach.

In this setting, consumer price differences between countries will be influenced by the cost of delivering the goods to them. There is a fixed trade cost of τ per unit of good x shipped between regions A and B. For trade between either of these countries and country C, the per-unit trade cost is σ. Trade costs should be interpreted in a wide sense, incorporating all differences between countries that make market integration imperfect (including, but not limited to, transport costs). Throughout the analysis we assume that $\sigma > \tau$.[13] The marginal costs of servicing market j from location i (c_{ji}) will then be a combination of the cost of the labour input w and the trade cost (0, σ, or τ):

$$
\begin{aligned}
c_{AA} = w, & \quad c_{BA} = w + \tau, & c_{CA} = w + \sigma, & \quad \text{FDI in } A; \\
c_{AB} = w + \tau, & \quad c_{BB} = w, & c_{CB} = w + \sigma, & \quad \text{FDI in } B; \\
c_{AC} = w + \sigma, & \quad c_{BC} = w + \sigma, & c_{CC} = w, & \quad \text{FDI in } C.
\end{aligned}
\tag{4}
$$

Given the firm's ability to segment its market, it will generally set a different consumer price for goods sold in each market. Let q_{ji} be the consumer price of the good when it is manufactured in country i and sold in country j. The firm's optimal consumer price will depend on the cost of servicing the market, which will be less for the domestic market than for export markets, as the former avoids trade costs. Since marginal costs of production are constant, the profit-maximising price and quantity can be calculated for each market independently.

A firm located in country i maximises its operating profits in each location j:

$$
\pi_{ji} = \left(q_{ji} - c_{ji}\right) X_j, \quad \forall i, j \in \{A, B, C\}.
\tag{5}
$$

Substituting the market demand curves (3) and marginal costs (4) into (5) and differentiating, yields profit-maximising consumer prices for each location:

$$
q_{ji} = \frac{\alpha + c_{ji}}{2}.
\tag{6}
$$

Substituting (6) into (5) gives optimised profits for each market. Total gross profits for the firm will be the sum of its operating profits in each market. From these, fixed, plant-specific costs must be deducted. We assume that these are the same across all countries and equal to F. Further, the

---

[13] Different arguments can be given to support this specification. The two markets in the union may be geographically closer

host country levies a lump-sum corporate income tax t_i, which can be positive or negative (that is, a subsidy)[14]

$$\pi_i = \sum_j \pi_{ji} - F - t_i, \quad \forall i,j \in \{A,B,C\}. \tag{7}$$

Due to symmetry, these profits are identical if the firm locates in either union country, A or B. In the following we adopt the convention, with no loss of generality, that the firm always locates in country A whenever it is indifferent between the two locations in the union. To simplify the notation we therefore confine our profit comparison to countries A and C:[15]

$$\pi_A^* = \frac{(\alpha - w)^2 + (\alpha - w - \tau)^2 + n(\alpha - w - \sigma)^2}{4\beta} - F - t_A,$$

$$\pi_C^* = \frac{2(\alpha - w - \sigma)^2 + n(\alpha - w)^2}{4\beta} - F - t_C. \tag{8}$$

Subtracting these two values from each other yields the net profit surplus that can be earned in location A vis-à-vis location C:

$$\pi_A^* - \pi_C^* = \frac{[2(\alpha - w) - \sigma][(2-n)\sigma - \tau] - \tau(\sigma - \tau)}{4\beta} - t_A + t_C. \tag{9}$$

The firm will be indifferent between locating in countries A and C if $\pi_A^* - \pi_C^* = 0$. Rewriting equation (9) we can then define λ as the "tax premium" that the firm is willing to pay for locating in country A as opposed to country C:

$$\lambda \equiv t_A - t_C = \frac{[2(\alpha - w) - \sigma][(2-n)\sigma - \tau] - \tau(\sigma - \tau)}{4\beta}. \tag{10}$$

This tax premium can be positive or negative. Intuitively, the optimal profit margin of the firm rises in each market when trade costs fall [cf. equations (4) and (6)]. Hence the firm prefers to locate in the country where *aggregate* trade costs are minimised. The requirement that profits in each

---

to each other than to the third country; there may be fewer administrative hurdles for trade between them; or the two markets in the union may be more similar, so that locating in one reduces the information cost of selling in the other.
[14] We focus on taxes (subsidies) on the flow of pure profits earned in every period of operation, rather than investment incentives in the form of start-up grants for greenfield investments. Modelling the corporate income taxes as *proportional*, rather than lump sum, would complicate the algebra but change none of the results.
[15] Throughout the analysis, we assume that the market size parameter α is sufficiently large, relative to wages, trade costs, and fixed set-up costs, to ensure positive profits for the firm in every location.

market, (8), are positive means that $2(\alpha - w) - \sigma > 0$. It can then be seen that country A can charge a higher tax than country C and still leave the firm indifferent between locations, if the market of the third country is not larger than the regional market ($n < 2$) and intra-union trade costs are small, relative to trade costs between the union and C ($\tau \ll \sigma$).

******* Figure 1 about here ******

Figure 1 summarises the parameter combinations under which union country A is able or unable to attract the investment in the absence of taxes and subsidies. The figure is drawn for the parameter values $\alpha = 2.5$, $w = 1$ and $\sigma = 1$, while the market size of country C (n) and trade costs within the union (τ) are allowed to vary. The boldface line in the graph is the locus $n_\lambda(\tau)$ along which the firm is indifferent between locating in the union and locating in country C. From (10), this has the form:[16]

$$n_\lambda(\tau) = \frac{(2\sigma - \tau)[2(\alpha - w) - \sigma] - \tau(\sigma - \tau)}{\sigma[2(\alpha - w) - \sigma]}. \tag{11}$$

For parameter combinations below this line the firm will settle in the union, whereas it will settle in country C for combinations above the line. It can be directly inferred from Figure 1 that further economic integration in the union, defined as a reduction in τ, increases the ability of country A to attract the FDI (cf. Motta and Norman, 1996).

2.3 Governments

Each government compares the welfare of its representative consumer in the scenarios where it is host to the firm to the cases where good x has to be imported from abroad. Due to international differences in trade costs, it also matters to the union countries, A and B, whether good x is imported from the neighbouring country in the union or from the outside country C. To compute the welfare level u_{Ai} for country A when the firm locates in country i, we use the budget constraint (2) to substitute for z_i in the

---

[16] Two benchmark cases can be directly inferred from equation (11). For $\tau = \sigma$ it follows that $n_\lambda = 1$ and all three countries have the same size and the same level of trade costs between them. For $\tau = 0$ we get $n_\lambda = 2$. In this case the two union countries are fully integrated and their joint market size is the same as that of the third country.

utility function (1) and then employ (3), (4), and (6). Noting that the tax term t_A is zero when country A is not host to the firm, we get

$$u_{AA} = \frac{(\alpha - w)^2}{8\beta} + w + t_A,$$

$$u_{AB} = \frac{(\alpha - w - \tau)^2}{8\beta} + w, \qquad (12)$$

$$u_{AC} = \frac{(\alpha - w - \sigma)^2}{8\beta} + w.$$

The welfare expressions for country B are analogous. For country C, there are only two different welfare levels, since that country is indifferent as to whether the firm locates in A or B:

$$u_{CA} = \frac{(\alpha - w - \sigma)^2}{8\beta} + w,$$

$$\qquad (13)$$

$$u_{CC} = \frac{(\alpha - w)^2}{8\beta} + w + \frac{t_C}{n}.$$

These equations determine the *best offer* (that is, the minimum tax) that each country is willing to grant to the firm in order to attract the investment. For country A, the tax depends upon whether the firm would otherwise locate in its union partner country B or in the outside country C. In the former case, the minimum tax is obtained by equating u_{AA} and u_{AB} in (12); whereas, in the latter case, the minimum tax equalises u_{AA} and u_{AC}. Denoting these minimum taxes by μ_{AB} and μ_{AC}, respectively, we get:

$$\mu_{AB} = \frac{-\tau[2(\alpha - w) - \tau]}{8\beta},$$

$$\qquad (14)$$

$$\mu_{AC} = \frac{-\sigma[2(\alpha - w) - \sigma]}{8\beta}.$$

Both of these expressions are unambiguously negative, indicating country A's willingness in either situation to subsidise the firm in order to save trade costs and ensure lower prices for consumers. Analogous best offers, μ_{BA} and μ_{BC}, are obtained for country B. To answer the question as to which alternative location induces a higher subsidy from country A, we calculate

$$\mu_{AC} - \mu_{AB} = \frac{(\tau - \sigma)\big[2(\alpha - w) - (\tau + \sigma)\big]}{8\beta} \leq 0. \tag{15}$$

For $\tau = \sigma$, $\mu_{AC} - \mu_{AB} = 0$ as country A views the alternative locations as being equivalent. As trade costs within the union fall $(\tau < \sigma)$, $\mu_{AC} - \mu_{AB} < 0$ indicating that country A is prepared to pay a higher subsidy to avoid importing the good from outside of the union.

For country C, equating u_{CC} and u_{CA} in (13) gives this country's minimum tax:

$$\mu_C = \frac{-n\sigma\big[2(\alpha - w) - \sigma\big]}{8\beta}, \tag{16}$$

which is also unambiguously negative. Comparing (16) with μ_{AC} in (14) shows that, for $n > 1$, country C will be willing to offer a higher subsidy than country A. This is because country C has the larger population and thus the higher absolute savings in trade costs (cf. Haufler and Wooton, 1999).

3   Tax competition between all countries

To determine the equilibrium location of the firm, the firm's comparison of net profits λ must be combined with the different minimum taxes offered by the competing countries. We adopt a simple bidding approach where all countries know the location preferences of the firm, as given by (10), and continuously improve their offers (that is, reduce their corporate income taxes). In equilibrium, the firm will locate in the country where its net-of-tax profits are (marginally) higher than those in any other location, and neither of the countries failing to get the investment has an incentive to reduce its tax further.

If all countries compete against each other, the union country A must outbid both its union partner B and the outside country C, in order to attract the investment. Country C's best tax offer is always μ_C. To outbid country C, country A's tax must match country C's best offer, taking account of the tax premium λ that the firm is willing to pay in the union vis-à-vis country C. We denote this profit-adjusted best offer of country C by μ_C^{λ}. From equations (16) and (10), we derive:

$$\mu_C^{\lambda} \equiv \mu_C + \lambda = \frac{[2(\alpha - w) - \sigma]\big[(4 - 3n)\sigma - 2\tau\big] - 2\tau(\sigma - \tau)}{8\beta}. \tag{17}$$

This acts as a critical tax for country A that will be negative if both n and τ are relatively large. However, it is positive for sufficiently low levels of both n and τ, in which case the firm has a strong incentive to settle in the union.

Tax competition between the two union countries is complicated by the fact that there are two best offers for each of countries A and B, depending on where the firm locates should the bidding country fail to attract the investment. For different values of the exogenous parameters (n, τ, σ), and for the corresponding set of best offers μ_{ij}, we can distinguish four regimes.

Regime I ($\mu_C^\lambda > \mu_{AB} > \mu_{AC}$)

In this regime, even the higher tax rate μ_{AB} will attract the firm to the union. Hence, it is a dominant strategy for country A to offer μ_{AB} and for country B to offer μ_{BA} ($=\mu_{AB}$). By our convention county A will be able to attract the firm and its equilibrium tax rate is $t_A^* = \mu_{AB}$. The welfare levels of countries A and B coincide in equilibrium.

Regime II ($\mu_{AB} > \mu_C^\lambda > \mu_{AC}$)

In this regime, the best offer of country A will depend on the offer of country B and vice versa. If country B offers a tax rate of (slightly below) μ_C^λ, and is thus able to attract the firm from country C, then the best offer of country A is μ_{AB}. If country B chooses μ_{BA}, however, then country A must offer μ_C^λ in order to prevent the firm from settling in country C. The same applies to country B. Formally:

$$\mu_A = \begin{cases} \mu_{AB} & \text{if} \quad \mu_B = \mu_C^\lambda \\ \mu_C^\lambda & \text{if} \quad \mu_B = \mu_{BA} \end{cases} \quad \text{and} \quad \mu_B = \begin{cases} \mu_{BA} & \text{if} \quad \mu_A = \mu_C^\lambda \\ \mu_C^\lambda & \text{if} \quad \mu_A = \mu_{AB} \end{cases}.$$

There are two equilibria in this regime: one at $(\mu_A = \mu_{AB}, \mu_B = \mu_C^\lambda)$, with country B attracting the firm; and another at $(\mu_A = \mu_C^\lambda, \mu_B = \mu_{BA})$, with country A attracting the firm. By our convention we concentrate on the case where country A hosts the firm, and its equilibrium tax rate is $t_A^* = \mu_C^\lambda$. Note that welfare in country B exceeds that of country A in equilibrium. But given that country B's tax rate is too high to attract the firm to the union, country A's best response is to attract the firm to its

country and earn a location rent equal to the difference between μ_C^λ and μ_{AC}. If country A attracts the firm there is in turn no reason for country B to change its initial tax offer μ_{BA}.

Regime III ($\mu_{AB} > \mu_{AC} > \mu_C^\lambda$ and $\lambda > 0$)

In this regime even the low tax rate μ_{AC} is unable to attract the firm to the union. Hence, the firm will settle in country C with an equilibrium tax rate of $t_C^* = \mu_{AC}$. In the absence of taxes, however, the firm would have settled in country A ($\lambda > 0$). As our discussion of equation (16) has shown, this is because country C is larger than country A and thus is willing to offer a lower tax rate.

Regime IV ($\mu_{AB} > \mu_{AC} > \mu_C^\lambda$ and $\lambda < 0$)

This regime has the same characteristics as Regime III. However, since $\lambda < 0$, country C will be able to attract the firm even if taxes are absent.

A graphical illustration of the different regimes is given in Figure 2. The borderline between Regimes I and II is calculated by equating μ_{AB} and μ_C^λ in equations (14) and (17). This yields

$$n_{AB}(\tau) = \frac{(4\sigma - \tau)[2(\alpha - w) - \sigma] - \tau(\sigma - \tau)}{3\sigma[2(\alpha - w)\sigma]}. \tag{18}$$

In Figure 2 this condition is shown graphically by the new line that cuts the horizontal axis at $n = 1.33$. To the left of this line, in Regime I, the intra-union rivalry dominates the competition for the investment. To the right of this line, in Regime II, the union must match the best offer of country C.

****** Figure 2 about here ******

Similarly, by equating μ_{AC} and μ_C^λ in (14) and (17), we can calculate the frontier $n_{AC}(\tau)$ which gives the borderline between Regimes II and III:

$$n_{AC}(\tau) = \frac{(5\sigma - 2\tau)[2(\alpha - w) - \sigma] - 2\tau(\sigma - \tau)}{3\sigma[2(\alpha - w) - \sigma]}. \tag{19}$$

In Figure 2 this locus cuts the horizontal axis at $n = 1.667$. To the left of this line, the difference is positive and the firm locates in the union despite intra-union tax competition. To the right of the frontier, in Regime III, the firm locates in the outside country C. Finally, Regime IV

shows the circumstances under which the firm would locate in country C in the absence of taxes, where the borderline between Regimes III and IV is determined by setting $\lambda = 0$ in equation (10).

Figure 2 shows that, in comparison to the scenario without taxes and subsidies (Figure 1), the ability of the union to attract the investment under tax competition is unambiguously diminished. This is due to the lower tax (higher subsidy) offered by the outside country C. The enhanced attractiveness of country C is represented by the area shown as Regime III.

In Figure 3 the equilibrium tax rate offered to the firm is plotted against n (the relative size of country C to that of each union member), for given levels of trade costs σ and τ. The best tax offers made to the firm by country A are given by the horizontal lines at μ_{AB} and μ_{AC}, where we have established in equation (15) that $\mu_{AC} < \mu_{AB} < 0$. Against these, we must set country C's best offer, adjusted for the firm's profit surplus in the union, as summarised by μ_C^λ. This is represented by the diagonal line, as the attractiveness of country C is linearly increasing in n [see equation (17)] and the incentive to locate in the union falls accordingly. Finally, the bold line shows the subsidy actually paid to the firm in equilibrium. The four panels of the diagram correspond to the regimes given above.

****** Figure 3 about here ******

Figure 3 shows that the equilibrium tax rate is generally falling as the size of country C, and hence this country's willingness to subsidise the firm, increases. At low levels of n, un upper limit is placed on the equilibrium tax rate by the competition between the two union countries (μ_{AB}). At high levels of n, the equilibrium tax rate is bounded from below by the best offer made by a single union country trying to prevent the firm from locating in country C (μ_{AC}).

4   Regional tax coordination

4.1   The optimal coordinated tax rate

We now consider the case where the union countries A and B coordinate their policies and jointly make a tax offer to the firm. This affects the results in two of the four regimes that we have introduced in the previous section.

First, the coordinated tax policy will never make a better offer than is needed to prevent the firm from locating in country C. The two union countries are no longer competing with one another and will not attempt to undercut each other's tax. Consequently, whenever country A attracts the firm, the equilibrium tax in the coordinated case is always $t_A^* = \mu_C^\lambda$. Therefore, a coordinated tax policy will lead to a higher equilibrium tax (smaller subsidy) in Regime I, where we have established that $t_A^* = \mu_{AB} < \mu_C^\lambda$ in the presence of tax competition between all countries. This tax increase will transfer some location rents from the firm to the treasury of country A and thus leads to a welfare gain for the union. This is shown in the left shaded area in Figure 4.

****** Figure 4 about here ******

The second important change occurs in Regime III. A regionally coordinated tax will take into account the combined benefits to both countries of the firm locating in the union rather than in country C. We maintain our convention that, if the firm invests in the union, it settles in country A. The maximum offer made under this coordinated policy is thus the sum of μ_{AC} and the benefit to country B of the firm locating in A rather than C. From the symmetry of the two union countries, this latter benefit is equal to $\mu_{AC} - \mu_{AB}$. The combined minimum tax for the union, denoted by μ_U, is thus found by summing terms in (14) and (15):

$$\mu_U \equiv 2\mu_{AC} - \mu_{AB} = \frac{[2(\alpha - w) - \sigma](\tau - 2\sigma) + \tau(\sigma - \tau)}{8\beta}. \qquad (20)$$

This minimum tax will be lower than the best offer of country A if and only if country B benefits from having the firm locate in A rather than C. From (15), we know that this condition is met whenever intra-union trade costs are less than the costs of importing from country C.

Given this offer, the equilibrium condition for the firm to locate in the union is $\mu_C^\lambda - \mu_U > 0$. Computing this difference from (17) and (20), we determine the frontier $n_{UC}(\tau)$ along which the firm would be indifferent between locating within or outside the union, given that each nation is making its best offer:

$$n_{UC}(\tau) = \frac{(2\sigma - \tau)[2(\alpha - w) - \sigma] - \tau(\sigma - \tau)}{\sigma[2(\alpha - w) - \sigma]}. \tag{21}$$

Comparison of (21) with (11), the expression for the frontier without taxes, reveals that the loci are identical. In other words, the combined tax offer of the union members exactly offsets the benefits to the firm of country C's best offer. Hence, the firm once again trades off the relatively greater size of country C's market against the lower level of trade costs within the union. In Figure 4, we see that the locus under regional tax coordination has swung back to re-establish the frontier that existed in the absence of tax incentives (as shown in Figure 1). By coordinating their taxes, the union thus recaptures the investment that had fallen into Region III. In this scenario the additional location rent to the union, relative to the case of intra-union tax competition, lies in the difference between the amount that must be offered to the firm to induce it to invest in the union (μ_C^λ), and the maximum coordinated subsidy that the union is willing to offer (μ_U).

In between these two cases, where regional tax coordination is welfare increasing, but with opposite implications for the direction of the coordinated tax reform, lies Regime II where tax coordination has no effect. This is the unshaded area in-between the two shaded sections in Figure 4. Here the union will attract the firm even if all countries compete against each other, and the binding constraint on the host country's tax level stems from the tax offer made by the outside country.

****** Figure 5 about here ******

The effects of coordination on the level of the tax are illustrated in Figure 5. A comparison of the bold lines in Figures 3 and 5 shows that the equilibrium tax rate will rise through regional tax coordination when intra-union competition for the firm dominates (Regime I). If the outside country is sufficiently small, then μ_C^λ is positive and the union will be able to charge a positive tax on the firm's income, instead of having to offer a subsidy. This cannot occur with intra-union tax competition, where the firm is always offered a subsidy in equilibrium. In contrast, the equilibrium tax rate falls when competition with the outside country is predominant (Regimes III and IV)

4.2   Consequences of a minimum tax

Given our results, what are the implications of a minimum corporate tax rate, as currently discussed in the EU? In the present framework we model this as a minimum tax rate $\mu^{\min}$ that raises the tax rate (reduces the subsidy) that country A is willing to offer the firm, in order to attract the investment. There are then two possible cases, both shown in Figure 6.

****** Figure 6 about here ******

In the first case, corresponding to Regime I, the outside country is small and the equilibrium tax rate in the presence of tax competition between all countries is $t_A^* = \mu_{AB}$. This is depicted in Figure 6 by the size parameter n_1, with the equilibrium at point **c**. In this case a minimum corporate tax rate $\mu_{AB}^{\min} > \mu_{AB}$ moves the equilibrium to **b** and thus acts at least as a partial substitute for the coordinated tax policy discussed in the previous section (which leads to an equilibrium at **a**). By collectively raising their tax rates, union members are able to transfer rents from the outside firm to their domestic treasuries, thus raising union welfare. This corresponds to the results in standard models of tax competition, whereby a restriction on national fiscal sovereignty overcomes a prisoner's dilemma situation that individual countries face in the absence of effective coordination.[17]

When the competition for the investment arises from outside the union, however, the minimum tax has effects contrary to its intended outcome. This case, corresponding to Regime II, is shown in Figure 6 where the outside country is larger, n_2. If all countries act in isolation, country A will attract the firm by making a tax offer slightly below μ_C^λ (with an equilibrium at point **e**) and captures a rent equal to the difference between μ_C^λ and its best offer μ_{AC} (the vertical distance between **e** and **f**). By imposing a constraint $\mu_{AC}^{\min} > \mu_C^\lambda > \mu_{AC}$ on country A, the minimum corporate tax moves the equilibrium to **d** and causes the firm to leave the region, leading to a welfare loss equal to the forgone location rent.

---

[17] In comparison to conventional models of tax competition in perfectly competitive markets, where tax coordination prevents an undersupply of public goods (e.g., Zodrow and Mieszkowski, 1986), the gains to the union are higher in our setting because the firm's profits do not enter the welfare measure of the union. The consequences of relaxing this assumption are explored in the following section.

Moreover, our discussion in the previous subsection has shown that a *reduction* in country *A*'s tax rate, relative to the uncoordinated case, will benefit the union as a whole in Regime III. Clearly these benefits cannot be reaped by a minimum corporate tax that instead forces a tax *increase* on country *A*. In sum, a minimum corporate tax imposed on each country in the region can thus act as a (partial) substitute for an explicit maximization of joint welfare when intra-union tax competition is dominant (Regime I), but it exacerbates the welfare losses from non-coordination when competition with the outside country dominates (Regimes II and III).

5   Discussion

Consider, first of all, how our results compare with previous findings on regional tax coordination in a three-country setting (Konrad and Schjelderup, 1999; Huizinga and Nielsen, 2000; Sørensen, 2000 and 2001). A common result to both these earlier papers and ours is that tax coordination is collectively beneficial for the region that undertakes the agreement. However, in the previous literature, welfare-improving tax coordination always leads to an *increase* in the rates of capital taxation, which reduces the deadweight loss of the tax system. In our model this is only one of two possible scenarios, and tax coordination may also involve a *reduction* in the tax offered to a monopolistic firm.

This latter policy may yield welfare gains because all of the benefits from attracting FDI to a region are internalised under tax coordination, including those of countries that do not host the firm. Such spillovers on neighbouring countries in the region are not captured by standard settings of capital-tax competition, where capital earns a normal rate of return and welfare changes in each country depend solely on the difference between the marginal costs of public funds and the marginal utility of private income. They do, however, arise in our model from the combination of profit-making firms and differential trade costs for trade within the union and between the union and the outside world.

The previous literature also typically finds that the countries outside the union benefit from the regional increase in tax rates (see Konrad and Schjelderup, 1999; Sørensen, 2000, 2001). As a consequence, models of tax competition in competitive capital markets predict that regions should

share a common interest in collectively raising capital tax rates, a least if they are sufficiently similar in size and other characteristics. This scenario raises the question as to why we do not observe more intensive efforts at *worldwide* tax coordination. In contrast, our setting introduces potentially conflicting interests between the union and the outside country. In particular, a coordinated tax reduction in the union will harm the outside country by redirecting FDI towards the integrating region.

In the present model, saving trade costs is the motive underlying governments' attempts to attract internationally mobile firms, and for the positive spillovers that exist for other countries in the region. It should be emphasised that, while this consumption spillover is both an intuitively appealing and analytically convenient example of the positive spillovers on the host economy, there are other candidates that could be incorporated in a model. This incentive to attract FDI might be enhanced by, for example, technological linkages that exist between the production of the monopolistic firm and the producers of other goods in the host country of the investment (see Haaland and Wooton, 1999; Kind *et al.*, 2000; Baldwin and Krugman, 2003). Positive spillovers of FDI on the host country could also be transmitted to neighbouring countries in the region via increased competition in the intermediate goods sector (Markusen and Venables, 1999). Hence, the basic argument derived from our analysis is not confined to the case where all firms produce final consumer goods, but it can equally be applied to tax competition for a firm producing specialised intermediate inputs.

A further example of positive spillovers are wage rigidities in the host countries, which imply that each additional job created by FDI is associated with a positive rent for workers (Haaparanta, 1996) and where increased rents to workers in one country are transmitted to neighbouring countries through worker mobility (Ludema and Wooton, 2000). Again, such a setting could yield results for the effects of regional tax coordination qualitatively similar to those from our specification with trade costs, strengthening the benefits from cooperation.

We now discuss the likely effects on the results of relaxing some of the underlying assumptions of our model. We have excluded the profits of the firm by assuming that they accrue to the residents of a (fourth) country not explicitly considered in the analysis. The firm's profits are

clearly affected by both forms of tax coordination. They are reduced if the firm has a strong incentive to settle in the region (Regime I) and the union countries collectively increase taxes to extract more rents from the firm. In contrast, the firm's profits increase if the union countries collectively reduce taxes in order to bid the firm away from country C (Regime III). If the firm is partly owned by residents of the union, then the union countries' changes in tax revenues are partly offset by counteracting changes in private profit income. This extension will reduce the gains from a coordinated tax increase in the union, but it will *increase* the gains from a coordinated tax reduction since the additional subsidies now partly accrue to domestic residents.

The benefits of regional tax coordination will also be affected if lump-sum taxes and subsidies are ruled out and distortionary taxes are the governments' marginal source of finance. Other things equal, this will put a premium on taxes raised from the firm and therefore increase the gains from a coordinated tax increase (Regime I). The reverse is also true, as this modification imposes an extra cost on subsidies paid out to the firm, and hence reduces the gains from a coordinated tax reduction (Regime III). Note that these departures from our results work in the opposite direction to the previous exercise of incorporating profit income accruing to residents of the union. Therefore, on the basis of these two simplifications alone, a setting where lump-sum taxes exist and all profit income accrues to non-residents may be seen as a simple benchmark that does not systematically bias our results in any particular direction.

Finally, our simple partial equilibrium model has only considered the location of a single firm in a particular industry. It is conceptually straightforward, however, to extend the discussion to a continuum of firms and industries. In such an extended setting the firms would typically differ with respect to the location rent (λ) that they earn in the union vis-à-vis the outside country, leading to a location equilibrium with a positive number of firms in each of Regimes I to III. A coordinated tax rise in the union, or the introduction of an EU-wide minimum corporate tax rate, would then have to weigh the aggregate gains from increasing tax receipts from the firms in Regime I against the losses in consumer surplus resulting from the outflow of firms in Regime II. While such a model would be far

more complex than the one presented here, our fundamental argument that the direction of a welfare-increasing tax coordination measure is ambiguous should carry through to this more general setting.

6 Conclusions

In this paper we have argued that regional tax coordination in a setting with a monopolistic firm and an outside country can lead to two types of welfare gains for the countries undertaking the agreement. First, for investments that would have taken place in the union in the absence of coordination, coordination allows an increase in equilibrium taxes, transferring location rents from the firm to the union countries. Second, by internalising the benefits to all union members from the location of a foreign production plant, the union as a whole may be able to attract the firm by means of a lower tax (or higher subsidy), whereas non-cooperative tax policies of its members would have caused the firm to settle outside the region.

These results seem to strengthen the policy case for a regional coordination of corporation taxes. But the analysis has also shown that the direction that a regionally coordinated tax reform should take is far from clear. Most of the policy discussion in the EU, together with the results from previous research, suggest a coordinated *increase* in corporation taxes. Yet the opposite conclusion is equally possible in a world where countries outside the region are not part of the agreement. Hence, the optimal coordinated policy for an integrated region such as the EU involves trading off changes in the location rents that can be reaped from existing firms with those associated with an increase or reduction in the number of firms that locate within the region.

Our analysis also holds some implications for the precise form that regional tax coordination should take. Throughout, we have considered only the welfare effects that regional tax coordination has on the union as a whole, leaving aside the issue of how these gains can be divided between individual member states. In particular, in situations where coordinated tax policy results in a lower tax than the best offers of each individual country, the host country would need to receive side-payments from its union partner(s) in order to submit a bid that is sufficiently low to attract the firm to the region. The most straightforward way to overcome this coordination problem would be by means of a centralised EU corporation tax. On the other hand, the analysis has also shown that permitting

bids by individual countries is a means of internalizing the positive spillovers that each country perceives from the location of mobile firms. A centralised EU corporation tax would eliminate this preference-revelation mechanism. Hence while this instrument could lead to an efficient distribution of firms between the EU and the rest of the world, it does not simultaneously guarantee an efficient distribution of firms between individual EU member states.

Finally, the trade-off for the regional coordination of tax policies described in this paper holds for a scenario where only a single tax instrument (the corporate income tax) is available to the union. In order to *simultaneously* increase the location rents from existing firms and attract new firms to the region, a richer set of tax instruments is needed. For example, a coordinated EU corporate tax policy could consist of a firm-specific location subsidy, which ensures that FDI with a positive net value to the union is indeed attracted, and a coordinated tax on corporate profits that avoids a mutual undercutting of individual EU member states. From a policy perspective, this is clearly at odds with both the EU's drive to eliminate discriminatory corporate tax practices and current EU competition policy, which holds that firm-specific subsidies are incompatible with the internal market (Article 87, EU-Treaty). However, it would be a potentially relevant exercise to endogenise EU competition policy and derive the optimal combination of tax and subsidy (competition) policies for a union of countries that faces competition from an outside country, but has more than one policy instrument at its disposal.

7 References

Baldwin, R., and P. Krugman (2003), Agglomeration, integration, and tax harmonization. *European Economic Review*, forthcoming.

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

De Mooij, R., and S. Ederveen (2001), Taxation and foreign direct investment: a synthesis of empirical research. *CESifo Working Paper* 588. Munich.

Devereux, M.P., and R. Griffith (1998), Taxes and the location of production: evidence from a panel of US multinationals. *Journal of Public Economics* 68, 335-367.

Devereux, M.P., R. Griffith, and A. Klemm (2002), Corporate income tax reforms and international tax competition. *Economic Policy* 35, 451-495.

European Communities (1998), Conclusions of the ECOFIN Council meeting on 1 December 1997 concerning taxation policy (including code of conduct for business taxation). *Official Journal of the European Communities* 98/C 2/01, Brussels.

Fumagalli, C. (2003), On the welfare effects of competition for foreign direct investment. *European Economic Review*, forthcoming.

Görg, H., and E. Strobl (2001), Multinational companies and productivity spillovers: a meta-analysis. *Economic Journal* 111, F723-F739.

Görg, H., and E. Strobl (2002), Spillovers from foreign firms through worker mobility: An empirical investigation. *IZA Discussion Paper* 591. Bonn.

Grubert, H., and J. Mutti (2000), Do taxes influence where U.S. corporations invest? *National Tax Journal* 53, 825-839.

Haaland, J.I., and I. Wooton (1999), International competition for multinational investment. *Scandinavian Journal of Economics* 101, 631-649.

Haaland, J.I., I. Wooton, and G. Faggio (2003), Multinational firms: easy come, easy go?, *Finanzarchiv* 59, 3-26.

Haaparanta, P. (1996), Competition for foreign direct investment. *Journal of Public Economics* 63, 141-153.

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

Haufler, A., and I. Wooton (2001), Regional tax coordination and foreign direct investment. *CEPR Working Paper* 3063. London.

Head, K., and T. Mayer (2002), Market potential and the location of Japanese investment in the European Union. *CEPR Working Paper* 3455. London.

Hines, J.R. (1999), Lessons from behavioural responses to international taxation. *National Tax Journal* 52, 304-322.

Horstman, I.J., and J .R. Markusen (1992), Endogenous market structures in international trade (natura facit saltum). *Journal of International Economics* 32, 109-129.

Huizinga, H., and S.B. Nielsen (2000), The taxation of interest in Europe: a minimum withholding tax? In: S. Cnossen (ed.), *Taxing capital income in the European Union,* 135-160. Oxford University Press.

IPAWorld (2003), Merck selects Jena, Germany for new plant. www.ipaworld.com, 7 March.

Keen, M. (2001), Preferential regimes can make tax competition less harmful. *National Tax Journal* 54, 757-762.

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.

Konrad, K., and G. Schjelderup (1999), Fortress building in global tax competition. *Journal of Urban Economics* 46, 156-167.

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

Markusen, J.R., E.R. Morey, and N.D. Olewiler (1995), Competition in regional environmental policies when plant locations are endogenous. *Journal of Public Economics* 56, 55-77.

Markusen, J.R., and A.J. Venables (1999) Foreign direct investment as a catalyst for industrial development. *European Economic Review 43*, 335-356.

Motta, M., and G. Norman (1996), Does economic integration cause foreign direct investment? *International Economic Review* 37, 757-783.

Rauscher, M. (1995), Environmental regulation and the location of polluting industries. *International Tax and Public Finance* 2, 229-244.

Razin, A., and E. Sadka (1991), International tax competition and gains from tax harmonization. *Economics Letters* 37, 69-76.

Ruding Report (1992), *Report of the committee of independent experts on company taxation*. Brussels and Luxembourg.

Sørensen, P.B. (2000), The case for international tax coordination reconsidered. *Economic Policy* 31, 429-472.

Sørensen, P.B. (2001), International tax coordination: regionalism versus globalism. *CESifo Working Paper* 483. Munich.

The Economist (2002), Let's start harmonising taxes. 14 November, p. 30.

Zodrow, G., and P. Mieszkowski (1986), Pigou, Tiebout, property taxation and the underprovision of public goods. *Journal of Urban Economics* 19, 356-370.

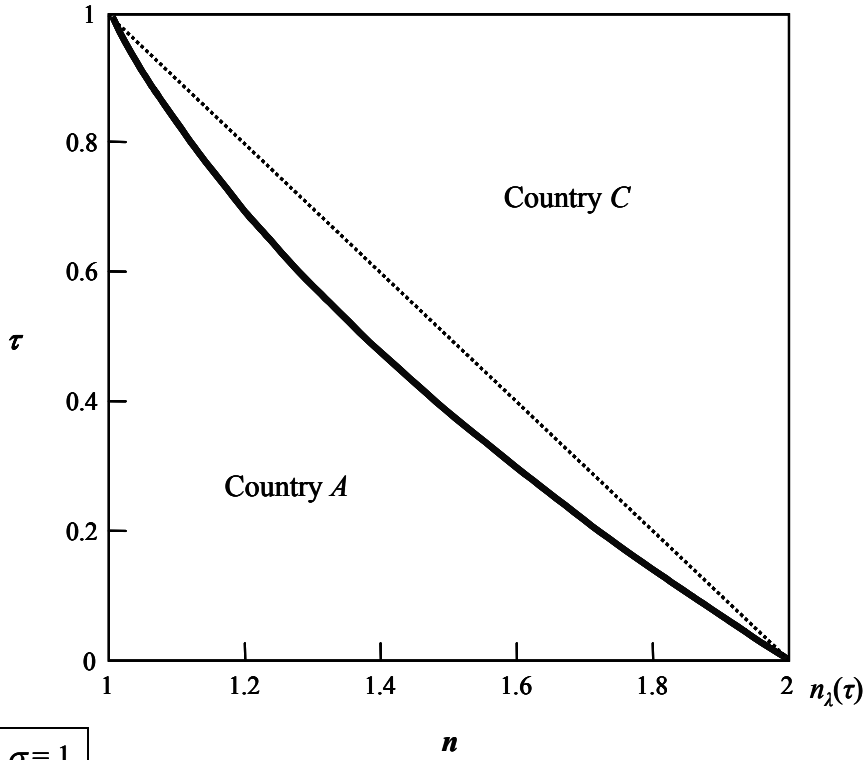**Figure 1. Location of firm in absence of tax competition**

Country C

Country A

τ

$n_\lambda(\tau)$

n

$\sigma = 1$

Figure 2. Location of firm under tax competition

$t_A^* = \mu_{AB}$ $t_A^* = \mu_C^\lambda$ $t_C^* = \mu_{AC}$

I   II   III   IV

τ

$n_{AB}(\tau)$ $n_{AC}(\tau)$

n

$\sigma = 1$
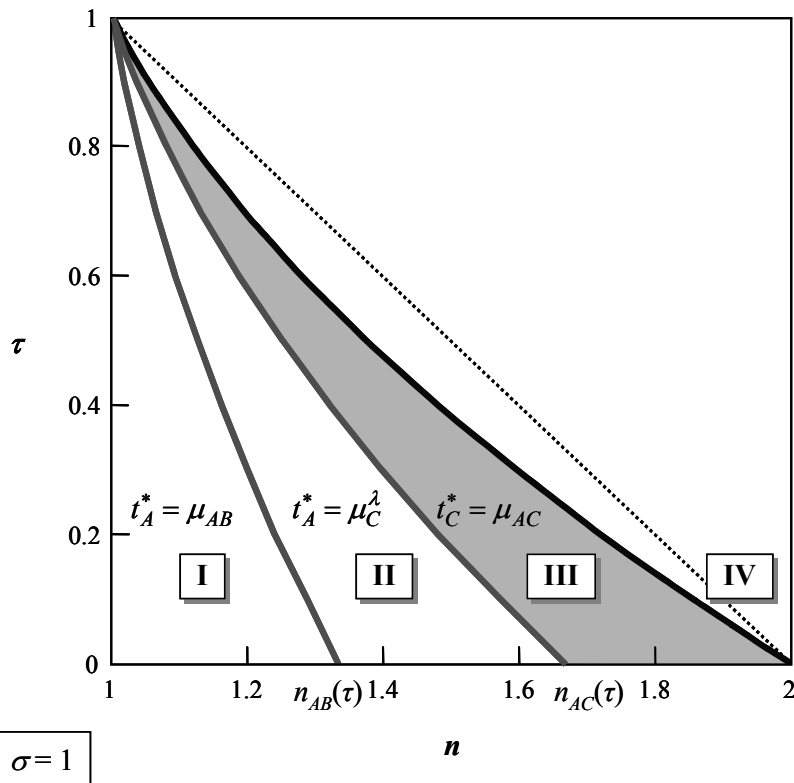
Figure 3. Tax levels under tax competition

locates in country A,
matching B's tax

locates in country A,
matching C's tax

locates in country C

$\tau = 0.1$, $\sigma = 1$
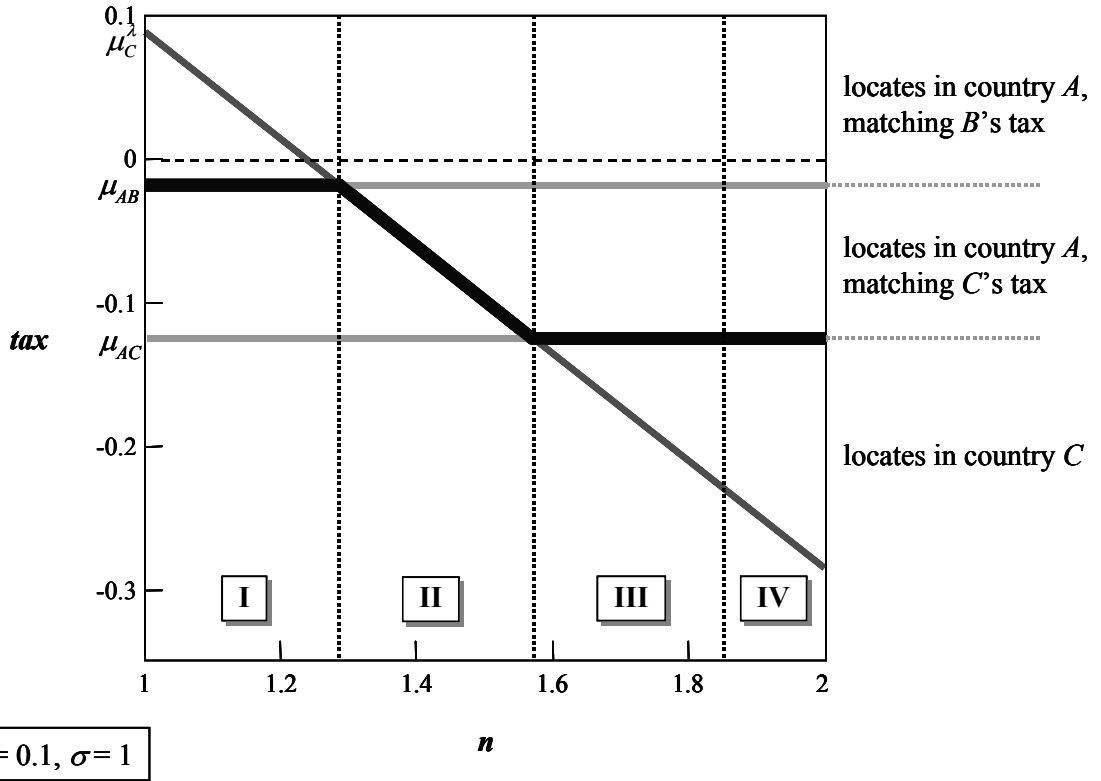
Figure 4. Location of firm under tax coordination

tax
increases

tax
declines

$\sigma = 1$
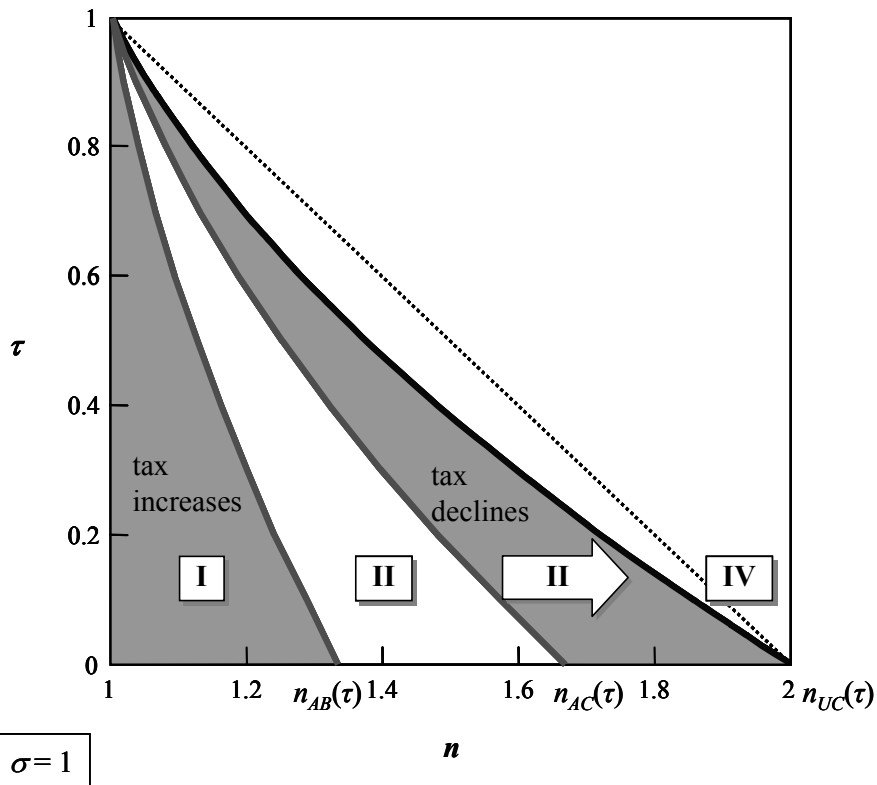
Figure 5. Taxes under tax coordination

0.1
μ_C^λ

0

μ_{AB}

still locates in country A,
now matching C's tax

still locates in country A,
matching C's tax

-0.1

μ_{AC}

now locates in country A,
matching C's tax

-0.2

μ_U

still locates in country C

tax

-0.3

| I | II | II | IV |

1   1.2   1.4   1.6   1.8   2

n

$\tau = 0.1,\ \sigma = 1$
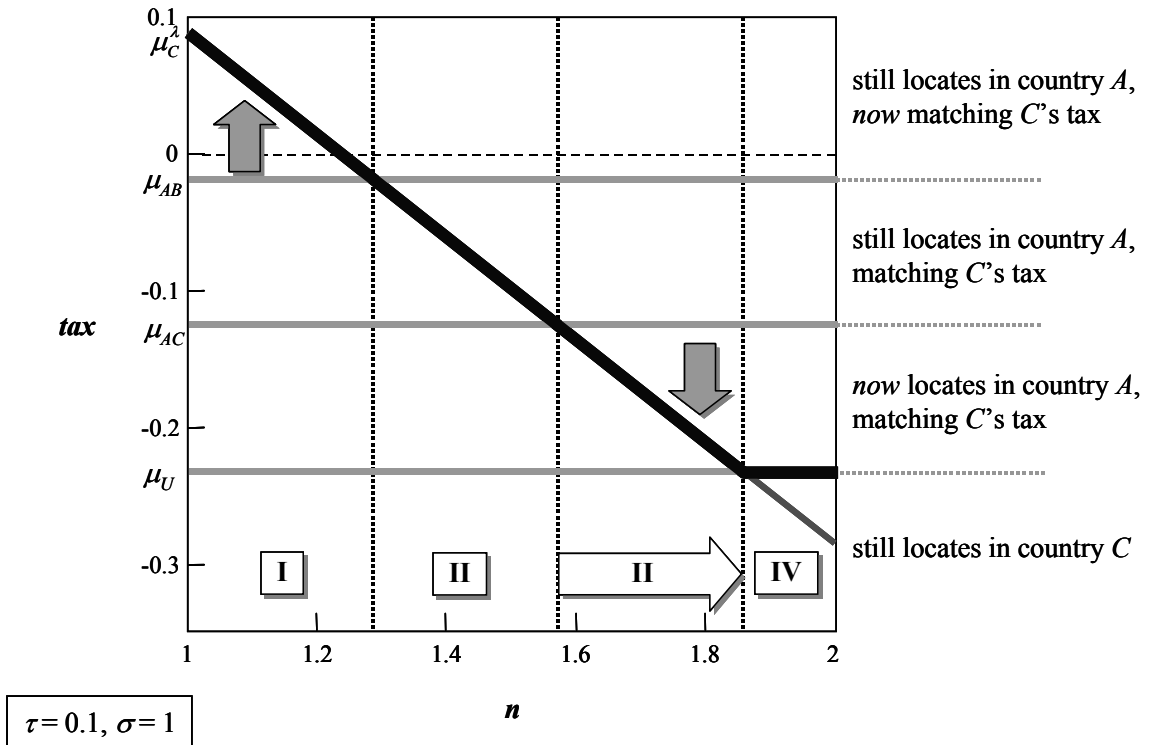
Figure 6. Consequences of a minimum tax

0.1
μ_C^λ

a

μ_{AB}^{min}

b

0

still locates in country A,
charging higher tax, μ_{AB}^{min}

μ_{AB}

c

μ_{AC}^{min}

d

-0.1

e

$\mu_{AC}^{min} > \mu_C^\lambda$, *now*
locates in country C

μ_{AC}

f

tax

-0.2

-0.3

1   n_1 1.2   1.4 n_2 1.6   1.8   2

n

$\tau = 0.1,\ \sigma = 1$