Transfer Pricing and Enforcement Policy in Oligopolistic Markets

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Abstract

We set up a symmetric two-country model with two multinationals competing on the quantities and possibly manipulating their transfer prices. Governments choose both the corporate profit tax rate and the level of enforcement of the "arm's length" principle. We show that stronger enforcement increases equilibrium tax rates. We also find that a larger international ownership of multinationals leads to a "race to the top" in both policies between the two countries, while trade liberalization initially implies a "race to the bottom". But as trade becomes free enough, a further decrease in trade costs raises equilibrium tax rates and enforcement policies.

Keywords: Multinational Enterprises; Transfer Pricing; Tax Competition; Enforcement Policy; Economic Integration.

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1 Introduction

Nowadays a large share of international trade occurs within multinational enterprises (hereafter MNEs) and manipulation of the transfer prices they use for internal transactions can shift a huge amount of taxable profits between countries. The empirical evidence almost unambiguously suggests that MNEs are able to reduce their worldwide tax payments by shifting profits from highly taxed to more lightly taxed jurisdictions.[1] Most of the empirical work is concerned with profit shifting from the United States to low-tax countries (or tax havens) and it relies mainly on statistical relationships between country tax rates and affiliate profitabilities or tax liabilities.[2] Clausing (2003) is a notable exception in that she analyzes U.S. data on intrafirm transfer prices to understand in what direction and to what extent these prices differ from those charged in outside markets due to tax rate differentials.[3]

Present international tax rules attempt to moderate - at least to some extent - these tax arbitrage activities through the principle that transactions within MNEs should be valued at their "arm's length" price, i.e. the price that would be paid by unrelated parties for similar transactions (OECD, 1995).[4] The same concern emerges from the U.S. regulations on transfer pricing, whose main objectives are to *"ensure that taxpayers clearly reflect income attributable to controlled transactions, and to prevent the avoidance of taxes with respect to such transactions"* (U.S. Department of the Treasury, 1994, p.34990). However, even though tax authorities of OECD countries are usually supposed to follow the standard guidelines for transfer pricing, Bartelsman and Beetsma (2003) show that profit shifting opportunities for MNEs do exist among OECD countries - including the U.S. - as well. Moreover, they provide evidence that the degree of enforcement of the "arm's length" principle differs across these countries. Table 1 summarizes the information about transfer pricing (TP) enforcement policies for the countries involved in their empirical analysis.[5]

[1] See Hines (1997, 1999) for comprehensive surveys of the empirical literature about tax-motivated transfer pricing and profit shifting by MNEs. We also refer the reader to Gresik (2001) and Gordon and Hines (2002) for an overview of the theoretical literature on international taxation and of its connections with empirical observations.

[2] See, e.g., Jenkins and Wright (1975), Grubert and Mutti (1991), Harris et al. (1993), Grubert, Goodspeed and Swenson (1993), Hines and Rice (1994).

[3] Her estimates indicate that a tax rate 1 percent lower in the country of destination (origin) is associated with intrafirm export (import) prices 1.8 percent lower (2 percent higher) relative to non-intrafirm goods.

[4] The OECD transfer pricing guidelines were first issued in 1979 and are updated periodically. They maintain the "arm's length" principle of treating related enterprises within a multinational group. Such a principle is also found in Article 9 of the OECD Model Tax Convention on Income and on Capital (OECD, 2003) and represents the framework for bilateral treaties between OECD countries and many non-OECD governments as well.

[5] Most countries have *explicit TP* rules, while a smaller group of countries uses *formal TP documentation* rules, meaning that tax authorities recommend taxpayers to maintain written

Country	Explicit TP rules	Formal TP documentation rules	TP specific penalties
Australia	07/83	09/95	07/83
Austria	-	-	-
Belgium	07/99	07/99	-
Canada	-	01/99	01/99
Denmark	01/99	01/99	-
Finland	01/31	-	-
France	09/85	04/96	04/96
Germany	02/83	-	-
Italy	12/86	-	-
Japan	04/86	-	-
Netherlands	-	-	-
Portugal	-	-	-
Spain	01/96	-	-
Sweden	-	-	-
United Kingdom	07/99	07/99	07/99
United States	01/28	01/94	01/94

Source: Ernst & Young (2000), cited in Bartelsman and Beetsma (2003, p.2230) and Peralta et al. (2003, p.3).

Table 1: Formal enforcement of transfer pricing rules by country

The purpose of this paper is to think about international taxation of MNEs and enforcement of the "arm's length" principle. These issues look increasingly important in a world where economic integration proceeds at a very rapid pace and the relevance of MNEs and intrafirm trade is undoubtedly rising.[6] Our work is essentially related to the literature which studies transfer pricing and tax competition in the presence of MNEs. For instance, Elitzur and Mintz (1996) model the trade-off for a MNE between the minimization of its worldwide tax payments and the incentives provided to the managing partner of a foreign subsidiary. They find that corporate tax rates are too high from a global welfare maximization perspective. Haufler and Schjelderup (2000) develop a tax competition model with investment and transfer pricing decisions by a MNE operating in two small countries. They show that the optimal policy is to accept some distortions of the investment decision - i.e. an incomplete deduction for the cost of capital - in order to reduce the incentive for the MNE to shift profits out of the country.

documentation showing that the prices charged for intrafirm transactions are consistent with the "arm's length" principle. And yet an even smaller set of countries imposes *TP specific penalties*. In Table 1, numbers indicate month and year of introduction of different TP related policies.

[6]About 33 percent of world trade was intrafirm already in 1993 (Markusen, 2002).

Mansori and Weichenrieder (2001) and Raimondos-Møller and Scharf (2002) study competition in transfer pricing regulations between two governments. In both models, the non-cooperative outcome implies an excessive taxation of the MNE because of a partial double taxation of its profits. However, none of these papers explicitly accounts for the impact that the degree of enforcement of the "arm's length" principle may have on the corporate profit tax rate set by the government, nor they analyze the effects of economic integration on the two policy instruments and on the product market equilibrium.

In such a sense, the analysis that we carry out below is close to and relies heavily on a bunch of papers by Kind, Midelfart Knarvik, and Schjelderup (2001, 2002, 2004, 2005), and is also based on the contributions by Peralta, Wauthy, and van Ypersele (2003, 2006). In particular, Kind et al. (2002) study the effects of economic integration on equilibrium taxes. They develop a symmetric two-country model with two MNEs - whose location is given - and where the corporate tax base is partly owned by residents in a third country (i.e. the rest of the world). The MNEs compete on quantities in the two markets and have to incur some costs in order to conceal transfer price manipulation. Such costs are reflected by an *exogenous* parameter and they are *tax-deductible*, meaning that tax authorities may not even know that they are related to transfer pricing. Trade liberalization is shown to reduce equilibrium taxes if MNEs are owned by third-country residents, but it increases them if MNEs are owned by home-country residents. Furthermore, increased international ownership leads to higher equilibrium tax rates. Peralta et al. (2003) instead set up a model where two *almost* symmetric countries compete both for the location of a single MNE and for the taxation of its profits. The MNE acts as a monopolist in the two markets and is required to follow the "arm's length" principle. Governments can decide between being strict or lenient on this requirement: such an "enforcement policy" is costless and essentially determined by government's reputation. As a result, transfer price manipulation implies a *non tax-deductible* cost for the MNE. Moreover, since the same tax rate applies to domestic firms as well, each government faces a trade-off between the benefit of attracting the MNE and the fiscal cost of hosting it. In such a framework, a country can optimally decide not to enforce the transfer pricing rule in order to attract the MNE, while setting high profit taxes on domestic firms. The other country, in turn, does not enjoy the benefits from the location of the MNE, but taxes its profits.

Our paper modifies the model by Kind et al. (2002) in two main respects: *i*) we add an extra fiscal policy variable, i.e. the level of enforcement of the "arm's length" principle, which is costly to the enforcing government; *ii*) we let transfer price manipulation costs to be a function of the enforcement level and make these costs non tax-deductible. In our model, the government of each country is thus endowed with two policy instruments: the corporate profit tax rate and the transfer pricing enforcement policy. The latter identifies the government's efforts and resources invested in forcing the domestic MNE to adhere to the "arm's length" principle. As in Peralta et al. (2006), the choice of such

a policy is *endogenous* and reflects government's attitude toward MNEs. To account for the possible interaction between the two fiscal policies and to analyze the effects of increased economic integration on both of them, we solve a three-stage game where governments choose first the enforcement level and then the corporate profit tax rate. In the last stage, the headquarters of the two MNEs set transfer prices to their foreign subsidiaries and compete on quantities in the two markets.

We show that, as governments increase the level of enforcement to discourage transfer pricing, equilibrium tax rates increase as well. Moreover, increased economic integration may lead to higher equilibrium tax rates and stronger enforcement. Namely, a larger third-country ownership of MNEs leads to a "race to the top" in both policies between the two countries. On the contrary, when MNEs are not fully owned by domestic residents, trade liberalization initially implies a "race to the bottom"; but as trade becomes free enough, a further decrease in trade costs increases both corporate tax rates and enforcement policies.

The rest of the paper is organized as follows. In Section 2, we outline the model. Section 3 illustrates the transfer pricing and quantity decisions by the MNEs when faced with the two policy instruments. In Sections 4 and 5, we derive the symmetric equilibrium tax rate and transfer pricing enforcement policy levels. Furthermore, we analyze and discuss the effects of increased economic integration on the two policy instruments. In Section 6, we summarize our main results and conclude.

2 The model

We consider a partial equilibrium model with two countries, i and j, which are identical in all respects, and two identical horizontally integrated MNEs. The location choices of MNEs are exogenously given and such that multinational enterprise MNE_i (resp., MNE_j) has headquarters in country i (j) and a foreign subsidiary in country j (i).

The production process within each MNE is divided into production of intermediate and final goods implying marginal costs c^I and c^F respectively. Without loss of generality, we postulate that all intermediate goods are produced at the headquarters and final production takes place locally. Therefore, part of the production of intermediate goods is further processed by the parent company and then sold in the domestic market, while the rest is exported to the foreign subsidiary for final processing and sale abroad. To make our point, we normalize to zero both marginal production costs so that $c^I = c^F = 0$. The marginal cost of the exporting parent company, c^I, plays the role of the "arm's length" price which the OECD recommends for the pricing of intrafirm transactions. As shall become clear below, the key to our argument is that while both countries are supposed to follow the "arm's length" principle, they can endogenously choose the corresponding level of enforcement.

The foreign subsidiary of, say, MNE_i is charged a transfer price, q_i, for each unit of

the intermediate good it buys from its headquarters. Since $c^I = 0$ by assumption, the transfer price is higher (lower) than the "arm's length" price when $q_i > 0$ ($q_i < 0$). The subsidiary also has to pay a per-unit trade cost, $\tau \geq 0$, which may reflect different types of barriers to international trade (e.g., transport costs and differing product standards), but does not include any kind of revenue generating tariffs imposed by governments.

The products of the MNEs are perfect substitutes in demand in both markets. That is, the two MNEs produce homogeneous goods and face the same inverse demand function

$$p_i = 1 - x_{ii} - x_{ji}, \tag{1}$$

where $p_i > 0$ is the price to consumers in country i, while x_{ii} and x_{ji} denote MNE_i's home sales and MNE_j's exports to country i respectively.[7]

We let π_{ii} and π_{ij} denote before-tax profits for MNE_i's parent company and foreign subsidiary: the first subscript indicates the headquarters' location and the second the country where profits are derived. Because of our specifications, domestic and foreign before-tax profits for MNE_i are given by

$$\pi_{ii} = p_i x_{ii} + q_i x_{ij}, \tag{2}$$

$$\pi_{ij} = (p_j - \tau - q_i) x_{ij}. \tag{3}$$

We assume that international corporate taxation follows the "source" principle, meaning that each country imposes a tax on the profits generated within its borders.[8] Furthermore, we postulate that tax authorities cannot directly observe the true production cost of the parent company, so that transfer prices may be manipulated in response to international tax differentials to shift taxable profits across countries.

To limit this profit shifting incentive and to formalize the evidence by Bartelsman and Beetsma (2003), we argue that governments are concerned about such a tax-avoiding strategy and try to induce domestic MNEs to meet the objective of national tax authorities. In particular, the government of, say, country i chooses a nonnegative level of enforcement, $\delta_i \in [0, \infty)$, of the "arm's length" principle and requires MNE_i to charge a

[7]Substituting for equilibrium quantities in country i's market, we find that $p_i > 0$ if and only if $\delta_j > \frac{(t_j - t_i)^2}{4(1+\tau)(1-t_i)}$, i.e. country j's enforcement level is sufficiently high. In any symmetric equilibrium in tax rates ($t_i = t_j$), the price to consumers in country i (resp., country j) will be positive as long as country j (country i) chooses a positive level of enforcement of the "arm's length" principle.

[8]This assumption is consistent with the actual behavior of most OECD countries. The "source" country typically has a first right to tax the profits of all firms operating within its borders. Then, some "residence" countries exempt the foreign profits of their subsidiaries from domestic tax, in which case the "source" principle applies directly. Alternatively, "residence" countries can use the tax credit method of double taxation relief. Even in this case, the "source" principle often effectively remains in operation because foreign profits are taxed only upon repatriation, which can be deferred by MNEs. See, e.g., Keen (1993).

transfer price (q_i) equal to the marginal production cost of the exporting parent company ($c^I = 0$).[9]

On the one hand, implementing such a policy entails a cost to the government, $C_i(\delta_i) = \frac{d}{2}\delta_i^2,\ d > 0$, which rises more than proportionally with the enforcement level. Intuitively, governments need to allocate resources to control the transfer pricing behavior of MNEs and the enforcement cost function is intended to reflect both the direct cost of this policy (e.g., the fact that tax authorities pay wages to people monitoring and controlling the accounts of MNEs) and its implicit opportunity cost. Since governments do not enjoy an infinity of resources (i.e. they face a budget constraint to respect), any amount of money spent on enforcement of the "arm's length" principle cannot be spent for other purposes. For example, if a government decides to allocate a given amount of money for this policy, it forgoes the opportunity to use that same money in order to improve the national health system, or to control levels of environmental pollution, and so on.[10]

On the other hand, a higher level of enforcement of the "arm's length" principle by country i's government makes it more costly for MNE_i to manipulate the transfer price on its intrafirm trade. Since the objective of tax authorities is to induce the MNE to set a transfer price as close as possible to the true production cost of the intrafirm traded good, overinvoicing and underinvoicing will be equally expensive for MNE_i, and manipulation costs will be higher the larger is the difference between q_i and c^I. Moreover, these costs will be proportional to the volume of intrafirm exports.[11] Namely, we let MNE_i's "transfer price manipulation" costs take the following form

$$TPM_i\left(\delta_i, q_i - c^I, x_{ij}\right) = \delta_i q_i^2 x_{ij},$$

and we assume that they are non tax-deductible. The idea is that governments are aware of the effect of their enforcement policies on these costs and know that MNEs need to hire financial experts (e.g., tax consultants, lawyers, or accountants) to keep track of their transfer pricing decisions and to show that they are consistent with the "arm's length" principle.[12] Therefore, MNE_i's objective function can be written as

$$\Pi_i = (1 - t_i)\pi_{ii} + (1 - t_j)\pi_{ij} - \delta_i q_i^2 x_{ij}, \tag{4}$$

[9] Following Kant (1988), the endogenous choice of the enforcement policy can be interpreted as a change in government's attitude toward MNEs, e.g. due to a change in the government in either country or to a study and policy review by an existing government.

[10] From a technical viewpoint, the convex specification of the enforcement cost function is needed for analytical tractability. This allows us to find a closed-form solution to the equilibrium enforcement policy which depends on the ownership structure of MNEs and on trade costs. If we assume, e.g., a linear cost of enforcement, $C_i(\delta_i) = d\delta_i,\ d > 0$, a symmetric equilibrium in enforcement policies still exists but the government's first-order condition is satisfied for any level of enforcement of the "arm's length" principle.

[11] The last assumption can be interpreted as a per-unit penalty which tax authorities impose on the MNE when they detect transfer price manipulation.

[12] If transfer price manipulation costs were tax-deductible, fiscal authorities might not be able

where t_i and t_j denote the corporate profit tax rate imposed by country i and country j respectively.

Turning to the government's objective function, we denote by $\alpha \in [0,1]$ the share of each MNE owned by domestic residents, while the residual $(1-\alpha)$ is owned by residents of a third country. Hence, welfare in country i can be expressed as[13]

$$W_i = CS_i + T_i + \alpha\Pi_i - C_i(\delta_i),$$

where $CS_i = \frac{1}{2}(x_{ii} + x_{ji})^2$ represents consumer surplus and $T_i = t_i(\pi_{ii} + \pi_{ji})$ is tax revenue. To show the different effects on welfare of the two policies and of the MNEs' ownership structure, the government's objective function can be rearranged as follows

$$W_i = CS_i + \underbrace{\alpha\left(\pi_{ii} + \pi_{ij}\right)}_{(I)} - \underbrace{\alpha t_j \pi_{ij}}_{(II)} + \underbrace{t_i\pi_{ji} + (1-\alpha)\, t_i\pi_{ii}}_{(III)} - \underbrace{\left(\alpha\delta_i q_i^2 x_{ij} + \frac{d}{2}\delta_i^2\right)}_{(IV)} \quad (5)$$

where

(I) the *profit ownership* effect shows that welfare increases with MNE_i's before-tax profits and with the share of such profits accruing to domestic residents;

(II) the *foreign tax exporting* effect indicates that country j has the ability to tax MNE_i's profits - by taxing its subsidiary - thereby reducing the amount available to country i residents; this effect decreases welfare in country i and is stronger the larger is the domestic ownership share of MNE_i;

(III) the *home tax exporting* effect increases welfare, since country i is able to shift the burden of taxation onto foreigners by taxing both MNE_j's foreign subsidiary profits and the share of MNE_i's parent company profits accruing to third-country residents;

(IV) the *enforcement policy* effect shows that the costs - in terms of welfare - of such a policy are increasing in the share of MNE_i owned by domestic residents.

Given this scenario, we solve a three-stage game characterized by the following order of moves:

- at the first stage, the two governments simultaneously set the level of enforcement of the "arm's length" principle, $\delta_i,\ \delta_j \in [0,\infty)$;

to distinguish them from production costs. The non tax-deductibility assumption is in line with Peralta et al. (2003). Instead, Kind et al. (2002) treat such "concealment costs" as tax-deductible.

[13] The parameter α can also be interpreted as the weight that each government puts on profits when it maximizes national welfare. If, say, $\alpha < 1$ and MNEs in both countries are fully owned by domestic residents, the government values consumer surplus, tax revenue and the cost of enforcement more than producer surplus.

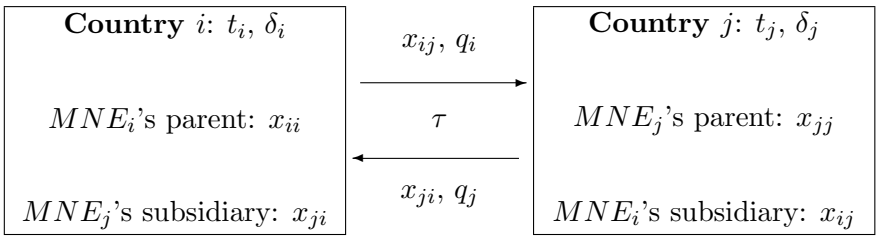

Figure 1: A graphical representation of the model

- at the second stage, the two governments simultaneously choose corporate profit tax rates, $t_i,\ t_j \in [0,1]$;
- at the third stage, the headquarters of the MNEs set transfer prices to their foreign subsidiaries and compete on quantities in the two markets.

This timing is consistent with Kind et al. (2002), where δ is an exogenous parameter which reflects how costly is for MNEs to manipulate the transfer price. In this paper, the two countries simultaneously choose their tax rates for a given δ and at the final stage Cournot competition between the two MNEs takes place. The same timing characterizes the model by Peralta et al. (2003) as well, where the sequence of decisions described above implies that country i's enforcement policy (δ_i) is essentially determined by government's reputation. Thus, it can be considered as a long-term policy variable.[14]

Figure 1 schematically illustrates our model by indicating the choice variables for governments (corporate tax rates and enforcement policies) and for MNEs (home sales, intrafirm exports and transfer price) as well as the existence of trade barriers between the two countries.

3 Transfer pricing and quantity decisions

We solve our three-stage game by backward induction. In the third stage, MNE_i maximizes its objective function (4) with respect to its home sales, exports and transfer price

[14]Implicitly, we have in mind a situation where regulators (i.e. fiscal authorities of the two countries) commit themselves not to modify their enforcement policies after corporate tax rates have been set. We must also stress that the choice of an alternative timing where, before deciding on their enforcement policies, the two governments choose tax rates, would make the model intractable and we would not obtain clear-cut results for the equilibrium values of the two policy instruments.

(x_{ii}, x_{ij} and q_i), taking the quantities supplied and the transfer price charged by MNE_j, the tax rates and the enforcement policies of both countries as given.[15]

3.1 Equilibrium transfer price

Using equations (1), (2) and (3), the equilibrium transfer price can be found by differentiating (4) with respect to q_i, which gives

$$q_i\left(t_i, t_j, \delta_i\right) = \frac{t_j - t_i}{2\delta_i}. \tag{6}$$

Note that the equilibrium transfer price only depends upon the tax rates set by the two governments and the enforcement policy of the domestic country.

Equation (6) illustrates the *profit shifting* incentive to manipulate the transfer price. If, say, $t_i > t_j$, MNE_i is induced to underinvoice its exports ($q_i < 0$) and shift profits to country j. Similarly, an incentive for overinvoicing ($q_i > 0$) and profit shifting into country i arises when $t_i < t_j$. Nevertheless, this profit shifting incentive is limited by country i's enforcement policy, δ_i. Intuitively, this policy should act in the same direction as the tax policy. Indeed, if country i is the high-tax country, MNE_i is induced to charge a negative transfer price, thereby shifting profits into country j. Hence, country i should set a higher enforcement level - as opposed to the case where it is the low-tax country - to keep as low as possible the negative effect transfer pricing may have on the profits declared by MNE_i's parent company. On the contrary, if both countries levy the same corporate profit tax rate ($t_i = t_j$), no profit shifting motive exists and MNE_i optimally sets its transfer price equal to the "arm's length" price, i.e. $q_i^* = c^I = 0$.[16]

To further investigate the previous argument, we derive the effects on the equilibrium transfer price of a marginal change in tax rates and in country i's enforcement policy

$$\frac{\partial q_i}{\partial t_i} = -\frac{\partial q_i}{\partial t_j} = -\frac{1}{2\delta_i} < 0, \tag{7}$$

$$\frac{\partial q_i}{\partial \delta_i} = \frac{t_i - t_j}{2\delta_i^2}. \tag{8}$$

Equation (7) shows that, as long as $\delta_i > 0$, a marginal increase in t_i induces MNE_i to lower its transfer price and shift profits out of country i. But the reduction in q_i turns out to be lower the higher is the level of δ_i. On the contrary, a marginal increase in t_j determines an increase in q_i so that MNE_i shifts a larger amount of profits into country i. But the rise in q_i turns out to be higher the lower is the level of δ_i. Both situations suggest that the enforcement policy of country i should work in the same direction as its tax policy in order to keep more profits within its borders.

Equation (8) confirms the last statement. If country i is the low-tax country, MNE_i is induced to overinvoice its exports to country j. Since $\partial q_i/\partial \delta_i < 0$, a marginal increase

[15] Clearly, MNE_j's maximization problem is symmetric.

[16] Here and in what follows, we denote by an asterisk the value of all the variables corresponding to the case of symmetric tax rates ($t_i = t_j$).

in δ_i decreases q_i and MNE_i can shift a lower amount of profits into country i. Hence, δ_i should be set as low as possible. On the other hand, if country i is the high-tax country, MNE_i is induced to underinvoice its exports to country j. In this case, $\partial q_i/\partial \delta_i > 0$ and country i should set δ_i as high as possible because the higher δ_i, the closer to the "arm's length" price (i.e. to zero) the transfer price q_i is, and the smaller the amount of profits that MNE_i is willing to declare in country j.

3.2 Equilibrium home sales and exports

Differentiating MNE_i's objective function (4) with respect to x_{ii} and x_{ij}, we get the following first-order conditions

$$\frac{\partial \Pi_i}{\partial x_{ii}} = 1 - 2x_{ii} - x_{ji} = 0, \tag{9}$$

$$\frac{\partial \Pi_i}{\partial x_{ij}} = (1-t_i)q_i + (1-t_j)(1 - 2x_{ij} - x_{jj} - \tau - q_i) - \delta_i q_i^2 = 0, \tag{10}$$

which, together with the symmetric expressions for MNE_j, implicitly define the best response functions of the two MNEs to a change in the quantities supplied on the two markets. Note that quantities are strategic substitutes ($\partial x_{ii}/\partial x_{ji} < 0$ and $\partial x_{jj}/\partial x_{ij} < 0$).

Solving (9) and (10) simultaneously for the two MNEs and using the equilibrium transfer price (6), we obtain equilibrium home sales and exports by MNE_i and MNE_j

$$x_{ii} = \frac{1+\tau}{3} - \frac{(t_j - t_i)^2}{12\delta_j(1-t_i)} \quad , \quad x_{jj} = \frac{1+\tau}{3} - \frac{(t_j - t_i)^2}{12\delta_i(1-t_j)}, \tag{11}$$

$$\underbrace{x_{ij} = \frac{1-2\tau}{3} + \frac{(t_j - t_i)^2}{6\delta_i(1-t_j)}}_{MNE_i} \quad , \quad \underbrace{x_{ji} = \frac{1-2\tau}{3} + \frac{(t_j - t_i)^2}{6\delta_j(1-t_i)}}_{MNE_j}. \tag{12}$$

When the two countries set symmetric corporate profit tax rates ($t_i = t_j$), equilibrium quantities reduce to

$$x_{ii}^* = x_{jj}^* = \frac{1+\tau}{3}, \quad x_{ij}^* = x_{ji}^* = \frac{1-2\tau}{3}, \tag{13}$$

and since the two MNEs are induced to set the same transfer price $q_i^* = q_j^* = 0$, their symmetric equilibrium before-tax profits are given by

$$\pi_{ii}^* = \pi_{jj}^* = \frac{(1+\tau)^2}{9}, \quad \pi_{ij}^* = \pi_{ji}^* = \frac{(1-2\tau)^2}{9}. \tag{14}$$

Equation (13) suggests that sufficiently high trade costs, i.e. $\tau \geq \frac{1}{2}$, would lead to negative exports for both MNEs. Thus, in order to have international trade in our model, we need to assume that $\tau \in \left[0, \frac{1}{2}\right)$. Furthermore, we easily see from (11) and (12) that a decrease in trade costs reduces domestic sales and simultaneously increases exports by both MNEs, thereby inducing more competition on the two markets.

3.2.1 Export incentive and enforcement policy

According to the expressions for equilibrium quantities, (11) and (12), home sales by the two MNEs are affected by the enforcement policy of the foreign country, while they are independent of the domestic enforcement policy. On the contrary, exports only depend upon the latter. Namely, differentiating (11) and (12) with respect to δ_i, we have that, as long as $t_i \neq t_j$

$$\underbrace{\frac{\partial x_{ii}}{\partial \delta_i} = \frac{\partial x_{ji}}{\partial \delta_i} = 0,}_{Country\ i's\ market} \quad \underbrace{\frac{\partial x_{ij}}{\partial \delta_i} < 0, \frac{\partial x_{jj}}{\partial \delta_i} > 0,}_{Country\ j's\ market}$$

implying that a marginal increase in δ_i has no impact on home sales by MNE_i, but leads to a decrease in its exports to country j. At the same time, it induces MNE_j to increase its home sales in country j, leaving unaffected its exports to country i. In other words, country i's enforcement policy affects the quantities sold in country j's market through its negative impact on exports by MNE_i.

To account for this observation, we need to put forward the *export* incentive faced by MNE_i. Substituting for the equilibrium transfer price (6), MNE_i's first-order condition (10) can be rewritten as follows

$$\frac{\partial \Pi_i}{\partial x_{ij}} = (1 - t_i)\left(\frac{t_j - t_i}{2\delta_i}\right) + (1 - t_j)\left[1 - 2x_{ij} - x_{jj} - \tau - \left(\frac{t_j - t_i}{2\delta_i}\right)\right] - \frac{(t_j - t_i)^2}{4\delta_i}. \quad (15)$$

If, regardless of a tax rate differential ($t_i \neq t_j$), MNE_i does not manipulate the transfer price and sets $q_i^* = 0$, it follows from (10) that $1 - 2x_{ij} - x_{jj} - \tau = 0$. Inserting the last expression into (15), we obtain

$$\frac{\partial \Pi_i}{\partial x_{ij}} = \frac{(t_j - t_i)^2}{4\delta_i} > 0.$$

Since it is optimal for MNE_i to increase its exports until the marginal profit from exports goes down to zero, we can argue that MNE_i will export more when there is room for manipulating the transfer price (i.e. $t_i \neq t_j$) than in the case of symmetric tax rates.

Such an export incentive - as well as the profit shifting incentive defined above - turns out to be decreasing in the level of country i's enforcement policy. This is precisely the reason why, even in the presence of a tax rate differential, an increase in δ_i induces MNE_i to decrease its exports to country j. Finally, consider what happens in country j's market. Since the two competing MNEs set their quantities simultaneously, MNE_j cannot observe MNE_i's actual behavior before setting its own quantity. It can however anticipate such a behavior by observing the enforcement policy level country i has previously chosen. Hence, if δ_i increases, MNE_j can anticipate that MNE_i will reduce its exports to country j and, since quantities are strategic substitutes, its optimal response will be to increase its home sales.

3.2.2 Strategic effect of corporate profit tax rates

In order to investigate how a change in country i's tax rate affects home sales and exports by the two MNEs, we derive the following expressions

$$\underbrace{\frac{\partial x_{ii}}{\partial t_i} = \frac{(t_j - t_i)(2 - t_i - t_j)}{12\delta_j (1 - t_i)^2}}_{Country\ i's\ market} \quad , \quad \underbrace{\frac{\partial x_{ij}}{\partial t_i} = \frac{t_i - t_j}{3\delta_i (1 - t_j)}}_{Country\ j's\ market}, \tag{16}$$

$$\underbrace{\frac{\partial x_{ji}}{\partial t_i} = \frac{(t_i - t_j)(2 - t_i - t_j)}{6\delta_j (1 - t_i)^2}}_{Country\ i's\ market} \quad , \quad \underbrace{\frac{\partial x_{jj}}{\partial t_i} = \frac{t_j - t_i}{6\delta_i (1 - t_j)}}_{Country\ j's\ market}, \tag{17}$$

whose sign only depends upon the difference between t_i and t_j as long as $\delta_i, \delta_j > 0$ and $t_i, t_j \neq 1$. In particular, if $t_i = t_j$, home sales and exports by the two MNEs are independent of the actual tax rates. Thus, a marginal increase in one of the tax rates starting from a symmetric equilibrium will not have any effect on supplied quantities. This will prove a useful property when deriving the equilibrium tax rate at the second stage.

Suppose now that $t_i \neq t_j$. We observe from (16) that, as long as $t_i < t_j$, a marginal increase in country i's tax rate induces MNE_i to increase its home sales and reduce its exports to country j. Furthermore, (17) suggests that MNE_j will respond to such a marginal increase in t_i by raising its home sales and decreasing its exports to country i. To account for these effects, we must recall that the two MNEs compete on the quantities knowing the tax rates which the two countries have previously set and that quantities are strategic substitutes. That is, we need to consider the *strategic effect* of tax rates on supplied quantities. When $t_i < t_j$, MNE_i is willing to overinvoice its exports and shift profits to country i, where the parent company resides. But a marginal increase in t_i will lower both the gain from manipulating the transfer price (profit shifting incentive) and the marginal profit of exports (export incentive). Thus, it will be optimal for MNE_i to decrease its exports to country j and increase its home sales. Given that tax rates are set before quantity competition, MNE_j can anticipate MNE_i's decisions and, since quantities are strategic substitutes, its optimal response will be to increase its home sales and decrease its exports to country i.

On the contrary, if $t_i > t_j$, a marginal increase in country i's tax rate will have opposite effects on supplied quantities. MNE_i will be induced to decrease its home sales and increase its exports to country j, while MNE_j will reduce its home sales and increase its exports to country i. In this case, we know that MNE_i is willing to underinvoice its exports and shift profits to country j, where the foreign subsidiary resides. Moreover, a marginal increase in t_i will increase even further its profit shifting and export incentives. Hence, MNE_i will behave more aggressively in country j and less aggressively in country i. As before, since MNE_j can anticipate MNE_i's behavior by observing tax rates, its best response will be to lower its home sales and raise its exports to country i.[17]

[17] When $t_i > t_j$ ($t_i < t_j$), we can reach the same conclusion by using the argument that a

4 Tax competition

At the second stage, the welfare maximization problem of the two countries is symmetric: each government sets its corporate profit tax rate in order to maximize national welfare, taking the tax rate of the other country and both enforcement policies as given. In particular, country i's government maximizes its welfare function (5) with respect to t_i, taking country j's tax rate, t_j, as well as δ_i and δ_j, as given. The corresponding first-order condition is given by

$$\begin{aligned}\frac{\partial W_i}{\partial t_i} &= \frac{\partial CS_i}{\partial t_i} + \alpha\left(\frac{\partial \pi_{ii}}{\partial t_i} + \frac{\partial \pi_{ij}}{\partial t_i}\right) - \alpha t_j \frac{\partial \pi_{ij}}{\partial t_i} + \pi_{ji} + t_i \frac{\partial \pi_{ji}}{\partial t_i} + (1-\alpha)\pi_{ii} \\ &+ (1-\alpha) t_i \frac{\partial \pi_{ii}}{\partial t_i} - \alpha\left(\delta_i q_i^2 \frac{\partial x_{ij}}{\partial t_i} + 2\delta_i q_i x_{ij} \frac{\partial q_i}{\partial t_i}\right) = 0,\end{aligned}$$

and we can easily show that the total effect of country i's tax rate on national welfare can be decomposed into three different effects

$$\begin{aligned}\frac{\partial W_i}{\partial t_i} &= \underbrace{\pi_{ji} + (1-\alpha)\,\pi_{ii}}_{Direct} + \underbrace{\left[(1-\alpha)\,t_i + \alpha\,(t_j - 2\delta_i q_i)\right] x_{ij} \frac{\partial q_i}{\partial t_i} - t_i x_{ji} \frac{\partial q_j}{\partial t_i}}_{TP} \\ &+ \left\{x_{ii} + (1-t_i)\,x_{ji} + (1-2x_{ii}-x_{ji})\left[\alpha + (1-\alpha)\,t_i\right]\right\} \frac{\partial x_{ii}}{\partial t_i} \\ &+ \left[\alpha\,(1-t_j)\,(1-2x_{ij}-x_{jj}-\tau) + (1-\alpha)\,q_i t_i + \alpha q_i\,(t_j - \delta_i q_i)\right] \frac{\partial x_{ij}}{\partial t_i} \\ &+ \left[x_{ji} + (1-\alpha)\,(1-t_i)\,x_{ii} + t_i\,(1-2x_{ji}-x_{ii}-\tau-q_j)\right] \frac{\partial x_{ji}}{\partial t_i} \\ &- \alpha\,(1-t_j)\,x_{ij} \frac{\partial x_{jj}}{\partial t_i} = 0,\end{aligned}$$

where *Direct* and TP denote, respectively, the *direct* effect on tax revenue (for constant transfer price and supplied quantities) and the *profit shifting* effect through transfer pricing, while the remaining terms represent the strategic effect of t_i on supplied quantities.

4.1 Symmetric tax rate and enforcement policies

In any symmetric equilibrium in tax rates ($t_i = t_j$), the two MNEs will find it optimal not to manipulate the transfer price and set $q_i^* = q_j^* = 0$. Moreover, their home sales and exports are independent of the actual tax rates. This means that the strategic effect on supplied quantities is equal to zero so that country i's tax rate affects national welfare only through the other two effects.[18] Hence, to keep our analysis as simple as possible, we assume that there exists a symmetric equilibrium in tax rates and define $t^* \equiv t_i = t_j$

marginal increase in t_i will have a positive (negative) impact on MNE_j's profit shifting and export incentives.

[18] Alternatively, we can show that a marginal change in one of the tax rates starting from a symmetric equilibrium will not affect consumer surplus, the profit ownership effect (I) and the enforcement policy effect (IV).

in any such equilibrium. We must stress that - at this stage - we do not need to require enforcement policies to be equal. In other words, the two countries do not necessarily have to choose the same level of enforcement of the "arm's length" principle (at the first stage) for a symmetric equilibrium in tax rates to - possibly - arise (at the second stage).

Evaluating the government's first-order condition at $t_i = t_j$ gives

$$\left.\frac{\partial W_i}{\partial t_i}\right|_{t_i=t_j} = \underbrace{\pi^*_{ji} + (1-\alpha)\,\pi^*_{ii}}_{Direct} + \underbrace{t^*\left(x^*_{ij}\frac{\partial q_i}{\partial t_i} - x^*_{ji}\frac{\partial q_j}{\partial t_i}\right)}_{TP} = 0, \tag{18}$$

and we substitute for (7), (13), (14) and $\partial q_j/\partial t_i = 1/2\delta_j$ to get

$$t^*(\delta_i, \delta_j, \alpha, \tau) = \frac{2\delta_i\delta_j\left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right]}{3(\delta_i+\delta_j)(1-2\tau)}. \tag{19}$$

The symmetric equilibrium tax rate depends on the enforcement policies by the two countries (δ_i and δ_j), on the ownership structure of MNEs (α) and on trade costs (τ). Such an optimal tax rate is equal to zero when one of the two countries decides not to enforce the "arm's length" principle, while it turns out to be positive as long as both δ_i and δ_j are positive.[19]

The symmetric solution to the government's problem allows us to analyze the effects that enforcement policies may have on corporate profit tax rates. Differentiating (19) with respect to δ_i and δ_j, we obtain

$$\frac{\partial t^*}{\partial \delta_i} > 0, \ \frac{\partial t^*}{\partial \delta_j} > 0, \ \frac{\partial t^*}{\partial \delta_i \partial \delta_j} > 0,$$

so that we can state

Proposition 1 *An increase in the level of enforcement of the "arm's length" principle by one of the two countries - or by both of them - increases the symmetric equilibrium tax rate.*

Proof See Appendix A1. □

A stronger enforcement of the "arm's length" principle will induce governments to increase the symmetric equilibrium tax rate, meaning that the two fiscal policy instruments at the government's disposal turn out to be complementary. Such a result can be explained as follows. The decision of a country's government to strengthen the enforcement level is based on the presumption that MNEs will have to bear higher costs to manipulate transfer prices in order to avoid taxes on their worldwide profits. As a result, tax authorities expect MNEs to declare profits which are closer to those actually earned in each jurisdiction. If, in addition, the two countries impose the same corporate profit tax rate, no profit shifting motive exists and a higher enforcement level makes it possible for governments to improve national welfare by taxing MNEs more heavily without losing

[19] See Appendix A1.

tax revenue. However, since enforcing the "arm's length" principle is costly, it cannot be optimal - from each country's government perspective - to spend an infinite amount of resources on that policy.

The following quotation - borrowed from Peralta *et al.* (2003) - nicely illustrates our theoretical set-up and seems to suggest that the way which national governments are taking to limit cross-country profit shifting is that of a stronger enforcement of the "arm's length" principle:[20]

> "In theory the transfer price is supposed to be the same as the market price between two independent firms [...]. So multinationals spend a fortune on economists and accountants to justify the transfer prices that suit their tax needs. Increasingly, firms try to restructure their operations to get their tax bill down as far as possible [...]. But tax authorities are increasingly looking out for such wheezes. In America, in particular, the taxman has been putting the squeeze on companies, which have responded by allowing more of their taxable profits to arise there to keep him happy. This is prompting other countries to get tougher, too."

4.2 Effects of economic integration

In our framework "economic integration" may be interpreted either as a more dispersed (or internationalized) ownership structure of the two MNEs or as trade liberalization. The former is represented by a decrease in the share of the domestic MNE owned by domestic residents (α) and by a corresponding increase in the ownership by third-country residents, while the latter is captured by a decrease in trade costs (τ).

We first consider the effect on t^* of a change in the ownership structure of MNEs. Differentiating (19) with respect to α, we find that

$$\frac{\partial t^*}{\partial \alpha} < 0,$$

which allows us to state

Proposition 2 *A more internationalized ownership structure of MNEs, i.e. a lower α, increases the symmetric equilibrium tax rate.*

Proof See Appendix A1. □

Intuitively, the larger is the share of the domestic *MNE* which is owned by residents in the rest of the world (or the lower is the domestic ownership share), the stronger is the incentive for governments to raise corporate tax rates, thereby shifting more of the tax burden onto foreigners.[21]

[20] Taken from "Gimme shelter", *The Economist*, January 27, 2000.

[21] This result is consistent with Huizinga and Nielsen (1997), whose model, however, does not consider transfer pricing by MNEs. They show that if economic integration means that a larger

The effects of trade liberalization on t^* depend on the ownership structure of MNEs. In order to disentangle the main forces driving our results, we analyze the two extreme cases where MNEs are fully owned either by domestic or by third-country residents.

With **full domestic ownership** ($\alpha = 1$), country i's first order-condition (18) reduces to

$$\left.\frac{\partial W_i}{\partial t_i}\right|_{t_i=t_j} = \underbrace{\pi^*_{ji}}_{Direct} + \underbrace{t^*\left(x^*_{ij}\frac{\partial q_i}{\partial t_i} - x^*_{ji}\frac{\partial q_j}{\partial t_i}\right)}_{TP} = 0.$$

A higher tax rate allows country i to tax more heavily the profits of MNE_j's subsidiary but it also leads to more profit shifting through transfer price manipulation. On the one hand, MNE_i is induced to decrease the transfer price charged to its subsidiary in country j ($\partial q_i/\partial t_i < 0$), thus increasing the profits of the latter and allowing country j to export more of its tax burden to country i's residents. On the other hand, MNE_j is induced to increase the transfer price for its subsidiary in country i ($\partial q_j/\partial t_i > 0$), thereby decreasing the subsidiary profits and reducing the scope for country i to tax foreigners.

Substituting for the symmetric equilibrium values of before-tax profits and exports, and using (7), we obtain

$$\left.\frac{\partial W_i}{\partial t_i}\right|_{t_i=t_j} = \underbrace{\frac{(1-2\tau)^2}{9}}_{Direct} - \underbrace{t^*\frac{(\delta_i+\delta_j)(1-2\tau)}{6\delta_i\delta_j}}_{TP} = 0.$$

Trade liberalization increases the profits of MNE_j's subsidiary in country i (*tax base expansion*), so that - for given transfer prices - more of the domestic tax burden can be exported to foreigners. However, a decrease in trade costs - for constant enforcement policies - leads to more profit shifting (*tax base loss*). The idea is that lower trade costs induce MNEs to increase their export volume; moreover, as t_i marginally increases with respect to t_j, both MNEs will gain by manipulating transfer prices on such intrafirm trade.

In the case of full domestic ownership, we easily prove that trade liberalization will *increase* the symmetric equilibrium tax rate.[22] This means that the positive direct effect on welfare of raising t_i when τ falls dominates the negative profit shifting effect.

With **full third-country ownership** ($\alpha = 0$), country i faces again a trade-off between the incentive to shift taxes onto foreigners and a potential loss of tax revenue

part of the corporate tax falls on foreigners, an incentive for "tax exportation" arises leading to a higher corporate tax rate.

[22]Ludema and Wooton (2000) obtain an analogous result in that lower trade costs may lead to higher equilibrium tax rates. Differently from us, they study the impact of tax competition on the location of manufacturing workers in an economic geography set-up. Baldwin and Krugman (2004) instead show that, by introducing agglomeration externalities into a standard tax competition model, greater economic integration may determine a "race to the top" in tax rates.

due to profit shifting. The only difference is that the direct effect consists now of both MNE_j's subsidiary and MNE_i's parent company equilibrium profits, which entirely accrue to third-country residents. Using equations (7), (13) and (14), the first-order condition becomes

$$\left.\frac{\partial W_i}{\partial t_i}\right|_{t_i=t_j} = \underbrace{\frac{(1-2\tau)^2}{9} + \frac{(1+\tau)^2}{9}}_{Direct} - \underbrace{t^* \frac{(\delta_i+\delta_j)(1-2\tau)}{6\delta_i\delta_j}}_{TP} = 0.$$

As before, if t_i increases, trade liberalization leads to a *tax base loss* because of transfer price manipulation. Here, however, the impact of trade liberalization on the direct effect turns out to be positive just for low values of trade costs.[23] The intuition behind this result is straightforward. Consider what happens when trade costs are prohibitive (i.e. $\tau = \frac{1}{2}$): MNE_j does not export to country i, so that its subsidiary earns no profits while MNE_i's parent company can earn monopoly profits. As τ decreases, MNE_j will eventually enter country i's market and its subsidiary will start earning positive profits; at the same time, MNE_i's parent company profits will reduce. Since monopoly profits are gradually replaced by lower total duopoly profits, the corporate tax base for country i's government shrinks (*tax base contraction*). Indeed, even if total duopoly profits rise again for lower values of τ, they will never reach the monopoly profit level in the absence of international trade. Therefore, if both MNEs are fully owned by third-country residents, trade liberalization will *decrease* the symmetric equilibrium tax rate, meaning that the direct effect on tax revenue is not positive enough to override the negative profit shifting effect.

To account for the relationship between t^* and τ for values of $\alpha \in (0,1)$, we differentiate (19) with respect to τ and get the following expression

$$\frac{\partial t^*}{\partial \tau} = \frac{4\delta_i\delta_j\left[1+5\tau-5\tau^2-\alpha(1+\tau)(2-\tau)\right]}{3(\delta_i+\delta_j)(1-2\tau)^2},$$

whose sign only depends on the term in square brackets. In particular, for $\alpha \in \left(0, \frac{1}{2}\right]$, the symmetric equilibrium tax rate monotonically decreases as a result of trade liberalization, meaning that the negative transfer pricing effect is always stronger than the direct effect on tax revenue. On the contrary, for $\alpha \in \left(\frac{1}{2}, 1\right)$, we find a non-monotonic relationship between t^* and τ. Intuitively, when trade costs are prohibitively high, the volume of intrafirm trade upon which MNEs can manipulate transfer prices is relatively small and profit shifting is negligible; if, moreover, third-country residents own a minimal share of the two MNEs, any positive tax rate will represent a pure tax on foreigners. Hence, t^* should be set as high as possible. However, as τ decreases, the corporate tax base becomes more sensitive to tax changes (since the scope for transfer price manipulation increases) and it will be optimal to decrease t^*. When trade costs eventually become low enough, the tax base expansion turns out to be more important for governments than

[23] See Appendix A1.

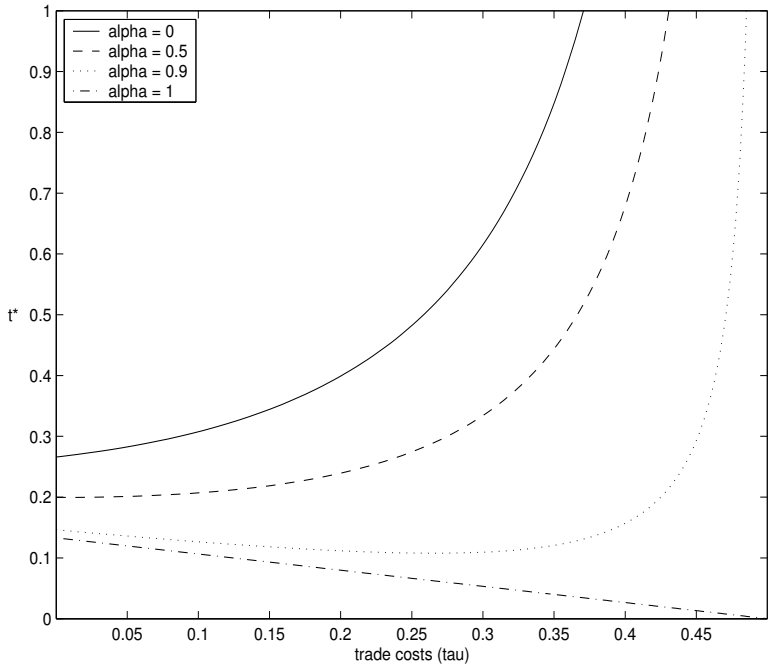

Figure 2: Effects of τ on t^* for $\delta_i = \delta_j$ and different values of α

the tax base loss due to transfer pricing, so that a further decrease in τ will - slightly - increase t^*.

In the following Proposition, we summarize our findings about the impact of trade liberalization on the symmetric equilibrium tax rate.

Proposition 3 *The effects of trade liberalization on the symmetric equilibrium tax rate depend on the ownership structure of the two MNEs.*
(i) If both MNEs are fully owned by domestic residents ($\alpha = 1$), a decrease in trade costs increases t^*.
(ii) If both MNEs are fully owned by third-country residents ($\alpha = 0$), a decrease in trade costs decreases t^*.
(iii) If the ownership structure of MNEs is such that $\alpha \in \left(0, \frac{1}{2}\right]$, i.e. third-country residents hold the majority of shares, a decrease in trade costs decreases t^*.
(iv) If the ownership structure of MNEs is such that $\alpha \in \left(\frac{1}{2}, 1\right)$, i.e. domestic residents hold the majority of shares, a decrease in trade costs increases t^* when trade costs are sufficiently low, i.e. for $\tau \in [0, \hat{\tau}]$. Otherwise, i.e. for $\tau \in \left(\hat{\tau}, \frac{1}{2}\right)$, a decrease in trade costs decreases t^*.

Proof See Appendix A1. □

Figures 2 and 3 illustrate the relationship between trade costs and the symmetric equilibrium tax rate for different values of α when the two countries choose the same

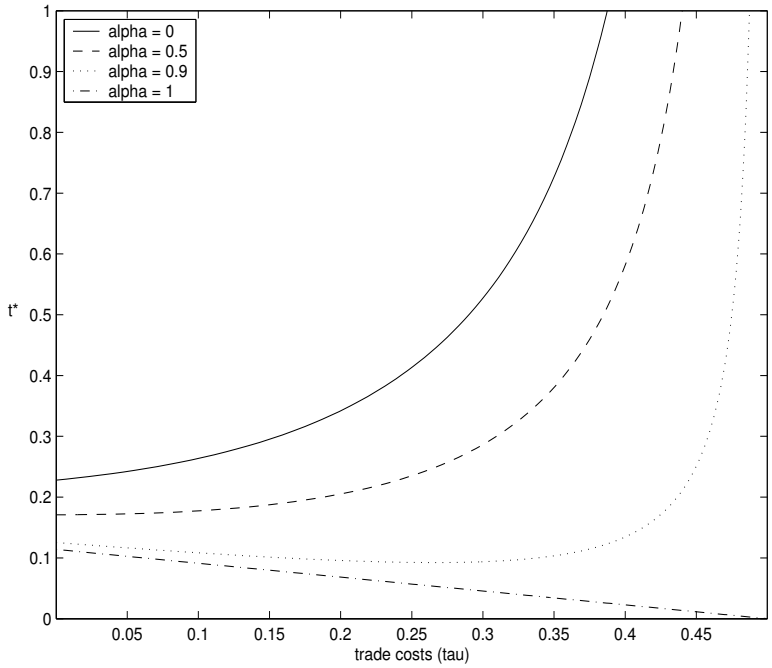

Figure 3: Effects of τ on t^* for $\delta_i \neq \delta_j$ and different values of α

level of enforcement ($\delta_i = \delta_j = 0.4$) and in the case of asymmetric enforcement policies ($\delta_i = 0.4$, $\delta_j = 0.3$), respectively. A comparison of the two figures reveals that an increase in the enforcement level by one of the two countries (here, country j) increases t^* for any value of α. Furthermore, we observe that - irrespective of whether enforcement policies are symmetric or not - the symmetric equilibrium tax rate increases with the ownership share of third-country residents while the effects of trade liberalization depend on the ownership structure of MNEs. On the one hand, t^* decreases with τ when foreigners hold the whole or the majority of shares in both MNEs ($\alpha = 0,\ \alpha = 0.5$); on the other hand, t^* increases as τ falls when MNEs are entirely owned by domestic residents ($\alpha = 1$). Finally, the non-monotonic relationship between t^* and τ for $\alpha = 0.9$ is consistent with result (iv) in Proposition 3.

5 Enforcement policy competition

At the first stage, each government chooses its level of enforcement of the "arm's length" principle in order to maximize national welfare, taking the enforcement policy of the other country as given. Substituting for the symmetric tax rate equilibrium values of transfer price, home sales, exports and before-tax profits, the government's objective

function (5) can be rewritten as

$$W_i^* = CS_i^* + \underbrace{\alpha\left(\pi_{ii}^* + \pi_{ij}^*\right)}_{(I)} - \underbrace{\alpha t^* \pi_{ij}^*}_{(II)} + \underbrace{t^* \pi_{ji}^* + (1-\alpha)\, t^* \pi_{ii}^*}_{(III)} - \underbrace{\left(\alpha \delta_i q_i^{*2} x_{ij}^* + \frac{d}{2}\delta_i^2\right)}_{(IV)},$$

which, using equations (13), (14) and (19), reduces to

$$W_i^* = \frac{1}{18}(2-\tau)^2 + \frac{\left(5\tau^2 - 2\tau + 2\right)\left[\alpha + (1-\alpha)\, t^*\right]}{9} - \frac{d}{2}\delta_i^2,$$

so that the first-order condition for the government's maximization problem is given by

$$\frac{\partial W_i^*}{\partial \delta_i} = \underbrace{\frac{(1-\alpha)\left(5\tau^2 - 2\tau + 2\right)}{9}\frac{\partial t^*}{\partial \delta_i}}_{Indirect} - \underbrace{d\delta_i}_{Implementation} = 0.$$

When setting its transfer pricing enforcement policy, country i must balance the positive impact of δ_i on the level of the symmetric equilibrium tax rate (*Indirect*) against a negative and direct effect reflected by the marginal cost of implementing δ_i itself (*Implementation*). It is evident that the direct effect does not vary with trade costs nor the ownership structure parameter. Instead, the indirect effect on national welfare of increasing δ_i turns out to be positively related to trade costs, in the case of full third-country ownership ($\alpha = 0$), and decreasing in domestic ownership, for any value of trade costs.[24] Hence, if the ownership share of foreigners in both MNEs increases, the benefits - in terms of national welfare - to enforce the "arm's length" principle increase as well.

By solving the first-order conditions simultaneously for the two countries, we find a symmetric equilibrium in transfer pricing enforcement policies, $\delta^* \equiv \delta_i = \delta_j$, which can be characterized as follows

Proposition 4 *There exists a symmetric equilibrium level of enforcement of the "arm's length" principle*

$$\delta^*(\alpha, \tau) = \frac{(1-\alpha)\left(5\tau^2 - 2\tau + 2\right)\left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right]}{54d(1-2\tau)},$$

which depends on the ownership structure of MNEs (α) and on trade costs (τ).

Proof See Appendix A2. □

The symmetric equilibrium enforcement level turns out to be nonnegative for all possible values of α and τ. In particular, we can immediately observe that $\delta^*(1, \tau) = 0$, while $\delta^*(\alpha, \tau) > 0,\ \forall \alpha \in [0, 1)$, so that we can state

Proposition 5 *If both MNEs are fully owned by domestic residents ($\alpha = 1$), the two countries will find it optimal not to enforce the "arm's length" principle. Otherwise, both countries will optimally choose a positive level of enforcement.*

[24] See Appendix A2.

The intuition for this result is simple. In the case of full domestic ownership, each country would incur the maximal costs - in terms of national welfare - to enforce the "arm's length" principle. Indeed, any positive level of enforcement would just have a negative impact because of its marginal implementation cost. On the contrary, when a minimal share of both MNEs is owned by foreigners, the enforcement policy has a positive impact on national welfare since it allows both countries to increase corporate profit tax rates and partly shift the burden of taxation onto foreigners.

To see how the ownership structure of MNEs affects the equilibrium enforcement policy, we derive the following expression

$$\frac{\partial \delta^*}{\partial \alpha} = -\frac{\left(5\tau^2 - 2\tau + 2\right)\left[5\tau^2 - 2\tau + 2 + \left(1+\tau^2\right)(1-2\alpha)\right]}{54d\,(1-2\tau)},$$

which is negative for all admissible values of α and τ. The positive effect of stronger enforcement is decreasing in α, while its marginal implementation cost is independent of such a parameter. Therefore, increased economic integration - in terms of larger international ownership of both MNEs - increases the equilibrium level of enforcement. This also confirms our previous result that the two countries optimally decide not to enforce the "arm's length" principle in the case of full domestic ownership ($\alpha = 1$).

When the two MNEs are fully owned by residents of a third country ($\alpha = 0$), we easily show that the equilibrium level of enforcement decreases with trade liberalization. Indeed, a decrease in trade costs reduces the positive impact on national welfare of increasing the enforcement level while leaving unaffected the implementation cost of such a policy.

Figure 4 illustrates the relationship between trade costs and the symmetric equilibrium enforcement policy for values of $\alpha \in (0,1)$ and $d = 1/27$. Trade liberalization initially leads to a decrease in δ^*, but when trade costs become sufficiently low, a further decrease in τ will increase δ^*. Such a non-monotonic relationship is consistent with the impact of trade liberalization on t^* when domestic residents hold the majority of shares in both MNEs. We can also compute a threshold value for the ownership structure parameter, $\hat{\alpha}(\tau)$, above which trade liberalization leads the two countries to increase the level of enforcement of the "arm's length" principle.

To conclude, our findings about the effects of increased economic integration on the equilibrium level of enforcement, δ^*, can be summarized as

Proposition 6 *A more internationalized ownership structure of both MNEs, i.e. a lower α, increases δ^*, for any level of trade costs. The effects of trade liberalization on δ^* instead depend on the ownership structure of MNEs.*
(i) If both MNEs are fully owned by third-country residents ($\alpha = 0$), a decrease in trade costs decreases δ^*.
(ii) If the ownership structure of both MNEs is such that $\alpha \in (0,1)$, that is the two MNEs are not fully owned by third-country nor domestic residents, there exists a threshold value, $\hat{\alpha}(\tau)$, for α, above which trade liberalization increases δ^*. Instead, for $\alpha < \hat{\alpha}(\tau)$, trade liberalization decreases δ^*.

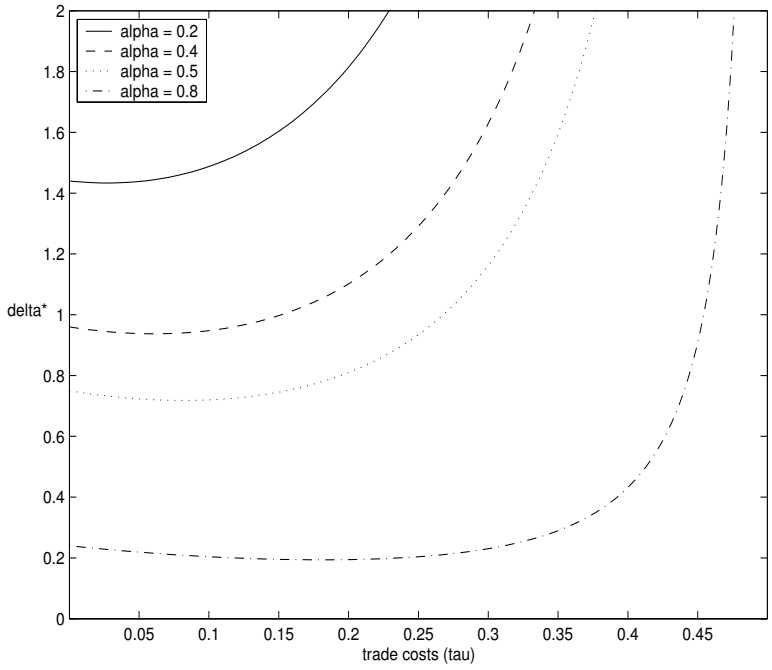

Figure 4: Effects of τ on δ^* for different values of α

Proof See Appendix A2. □

6 Concluding remarks and possible extensions

In this paper we have examined and discussed the outcome of a three-stage game where the governments of two symmetric countries set corporate profit tax rates and choose the level of enforcement of the "arm's length" principle to maximize national welfare, taking into account the strategic choices of two MNEs competing on the quantities in the two markets. Our purposes have been to study how enforcement policies affect the tax competition game and to understand in what direction economic integration - in terms of lower trade costs or a more internationalized ownership structure of MNEs - influences the symmetric equilibrium levels of the two fiscal policy instruments.

In line with Kind *et al.* (2002), we have found that increased international ownership of MNEs unambiguously leads to higher corporate profit tax rates. Huizinga and Nicodeme (2003, 2006) offer empirical support for such a theoretical result by suggesting that corporate tax burdens in Europe are positively related to foreign ownership shares at the country level.[25] We have further shown that the effects of trade liberalization depend on the ownership structure of MNEs.

[25]According to their estimates, an increase in foreign ownership by 1 percent would lead to an increase in the average corporate tax rate by between 0.5 and 1 percent.

- If both MNEs are fully owned by third-country (domestic) residents, a decrease in trade costs decreases (increases) equilibrium tax rates.
- If both MNEs are partly owned by foreigners and partly by domestic residents, with the latter holding the majority of shares, trade liberalization increases equilibrium tax rates when trade costs become sufficiently low.

Therefore, increased economic integration may lead either to a "race to the bottom" or to a "race to the top" in corporate profit tax rates between the two countries. While the former represents a good analogy with the standard results in the tax competition literature, the latter contrasts with the conventional conclusion that, due to tighter economic integration, tax competition between countries for a mobile tax base should imply a downward pressure on tax rates.[26]

Our model also predicts that, as governments increase the level of enforcement of the "arm's length" principle to control the transfer pricing behavior of MNEs and to avoid cross-country profit shifting, equilibrium tax rates increase as well. Such a result suggests that there exist a *complementarity* between the two fiscal instruments in the sense that one country's enforcement policy should work in the same way as its corporate tax rate in order to reduce profit shifting incentives for domestic MNEs. In other words, high-tax countries should choose higher level of enforcement policies with respect to low-tax countries. Moreover, when MNEs are not fully owned by domestic residents, increased economic integration may determine a "race to the top" in transfer pricing enforcement policies between the two countries. While an increase in the international ownership share of MNEs monotonically increases the equilibrium level of enforcement, trade liberalization initially has an opposite effect on this policy. But as trade free becomes free enough and depending on the ownership structure of MNEs, a further decrease in trade costs may increase the equilibrium enforcement policy. Instead, when MNEs are fully owned by domestic residents, it is optimal for both countries not to enforce the "arm's length" principle. In such a case any positive level of enforcement would uniquely have a negative impact on national welfare because of its marginal implementation cost.

To sum up, our results may be interpreted in the light of two different views of the economic integration process. On the one hand, if we look at increased economic integration just as a matter of internationalization of the ownership structure of MNEs, we have found that, for any given level of trade costs, both equilibrium tax rates and enforcement policies will increase. Each country's government, by allocating more resources to control transfer pricing, is able to increase its corporate profit tax rate. Moreover, as the share of foreign ownership in the domestic MNE gets larger, increasing its tax rate allows each country to shift more of the tax burden onto foreigners. Hence, such an internationalization phenomenon will lead to a "race to the top" in both policy instruments between

[26] We refer the reader to Wilson (1999) for a recent survey of the tax competition literature. See also Wildasin and Wilson (1991) for a comprehensive overview of public finance models with symmetric countries.

countries.

On the other hand, if we consider economic integration only in terms of trade liberalization, we have proved that, starting from a high level of trade costs and as long as MNEs are not fully owned by domestic residents, a "race to the bottom" in tax rates and enforcement policies will take place between the two countries. Then, when trade becomes free enough and depending on the ownership structure of MNEs, a further decrease in trade costs may increase the level of both policy instruments again. Indeed, the tax base expansion may be more important for each country's government than the tax base loss due to transfer pricing.

Most - if not all - of our results are driven by the symmetric-country assumption and by the existence of a symmetric equilibrium in corporate tax rates. Therefore, as a task for future research, it looks important to analyze situations where countries (or MNEs) differ in some respects. For instance, we could imagine a set up with a single MNE and two countries. By letting production of the intermediate good take place just where the MNE's parent company is located and by further assuming that the MNE is fully owned by residents of that country, governments will find themselves in an asymmetric position relative to the MNE and their objective functions will be substantially different. Indeed, due to the presence of trade costs, consumers living in the country hosting the MNE's subsidiary will have to pay a higher price for the final good than those living in the other country. Moreover, all of the MNE's profits will accrue to people residing in the latter country. Hence, optimal corporate tax rates and enforcement policies might no longer be symmetric across countries. Alternatively, we could think about more complicated forms for the ownership structure of MNEs. In our model, country i's (country j's) residents do not hold any share of MNE_j (MNE_i). But things are likely to behave differently if we allow for (partial) international cross-ownership of MNEs.

Appendix A1: Tax competition

Symmetric equilibrium tax rate

We need to point out that the symmetric outcome of the tax competition stage, $t_i = t_j \equiv t^*(\delta_i, \delta_j, \alpha, \tau)$, is a local Nash equilibrium under some parameter configurations. To prove this, we check that the government's second-order condition is - or rather can be - negative at $t_i = t_j$. We let

$$\begin{aligned}
A &\equiv x_{ii} + (1-t_i)\,x_{ji} + (1-2x_{ii}-x_{ji})\,[\alpha + (1-\alpha)\,t_i]\,,\\
B &\equiv \alpha\,(1-t_j)\,(1-2x_{ij}-x_{jj}-\tau) + (1-\alpha)\,q_i t_i + \alpha q_i\,(t_j - \delta_i q_i)\,,\\
C &\equiv x_{ji} + (1-\alpha)\,(1-t_i)\,x_{ii} + t_i\,(1-2x_{ji}-x_{ii}-\tau-q_j)\,,\\
D &\equiv \alpha\,(1-t_j)\,x_{ij},\\
E &\equiv (1-\alpha)\,t_i + \alpha\,(t_j - 2\delta_i q_i)\,,
\end{aligned}$$

and compute country i's government second-order condition as follows

$$\begin{aligned}\frac{\partial^2 W_i}{\partial t_i^2} &= \frac{\partial \pi_{ji}}{\partial t_i} + (1-\alpha)\frac{\partial \pi_{ii}}{\partial t_i} + E\left(\frac{\partial x_{ij}}{\partial t_i}\frac{\partial q_i}{\partial t_i} + x_{ij}\frac{\partial^2 q_i}{\partial t_i^2}\right) + x_{ij}\frac{\partial q_i}{\partial t_i}\frac{\partial E}{\partial t_i} \\ &- x_{ji}\frac{\partial q_j}{\partial t_i} - t_i\frac{\partial x_{ji}}{\partial t_i}\frac{\partial q_j}{\partial t_i} - t_i x_{ji}\frac{\partial^2 q_j}{\partial t_i^2} + A\frac{\partial^2 x_{ii}}{\partial t_i^2} + \frac{\partial x_{ii}}{\partial t_i}\frac{\partial A}{\partial t_i} \\ &+ B\frac{\partial^2 x_{ij}}{\partial t_i^2} + \frac{\partial x_{ij}}{\partial t_i}\frac{\partial B}{\partial t_i} + C\frac{\partial^2 x_{ji}}{\partial t_i^2} + \frac{\partial x_{ji}}{\partial t_i}\frac{\partial C}{\partial t_i} - D\frac{\partial^2 x_{jj}}{\partial t_i^2} - \frac{\partial x_{jj}}{\partial t_i}\frac{\partial D}{\partial t_i}\end{aligned}$$

where

$$\frac{\partial^2 x_{ji}}{\partial t_i^2} = -2\frac{\partial^2 x_{ii}}{\partial t_i^2} = \frac{(1-t_j)^2}{3\delta_j(1-t_i)^3} \quad , \quad \frac{\partial^2 x_{ij}}{\partial t_i^2} = -2\frac{\partial^2 x_{jj}}{\partial t_i^2} = \frac{1}{3\delta_i(1-t_j)},$$
$$\frac{\partial^2 q_i}{\partial t_i^2} = \frac{\partial^2 q_j}{\partial t_i^2} = 0 \quad , \quad \frac{\partial E}{\partial t_i} = 1-\alpha-2\alpha\delta_i\frac{\partial q_i}{\partial t_i}.$$

When $t_i = t_j \equiv t^*$, we know from equations (16) and (17) that the strategic effect of corporate profit tax rates on supplied quantities is equal to zero. Moreover, $q_i^* = q_j^* = 0$, $x_{ii}^* = x_{jj}^* = \frac{1+\tau}{3}$, $x_{ij}^* = x_{ji}^* = \frac{1-2\tau}{3}$, and we also have that

$$\left.\frac{\partial \pi_{ji}}{\partial t_i}\right|_{t_i=t_j} = -x_{ji}^*\frac{\partial q_j}{\partial t_i} \quad , \quad \left.\frac{\partial \pi_{ii}}{\partial t_i}\right|_{t_i=t_j} = x_{ij}^*\frac{\partial q_i}{\partial t_i},$$
$$A^* = \frac{2-\tau-t^*(1-2\tau)}{3} \quad , \quad B^* = 0,$$
$$C^* = \frac{1-2\tau+(1-t^*)(1-\alpha)(1+\tau)}{3} \quad , \quad D^* = \frac{(1-2\tau)(1-t^*)\alpha}{3},$$
$$\left.\frac{\partial^2 x_{ii}}{\partial t_i^2}\right|_{t_i=t_j} = -\frac{1}{6\delta_j(1-t^*)} \quad , \quad \left.\frac{\partial^2 x_{jj}}{\partial t_i^2}\right|_{t_i=t_j} = -\frac{1}{6\delta_i(1-t^*)}.$$

Therefore, substituting for $\partial q_i/\partial t_i = -1/2\delta_i$ and $\partial q_j/\partial t_i = 1/2\delta_j$ and evaluating the government's second-order condition at $t_i = t_j$ gives

$$\left.\frac{\partial^2 W_i}{\partial t_i^2}\right|_{t_i=t_j} = \underbrace{-\frac{1-2\tau}{3}\left(\frac{1}{\delta_j}+\frac{2-\alpha}{2\delta_i}\right)}_{(a)}\underbrace{-\frac{1}{6(1-t^*)}\left(\frac{A^*-2C^*}{\delta_j}-\frac{D^*}{\delta_i}\right)}_{(b)}.$$

Since the first term on the RHS, (a), is always negative for any value of $\delta_i, \delta_j \in [0,\infty)$, $\alpha \in [0,1]$, and $\tau \in \left[0, \frac{1}{2}\right)$, while the second term, (b), can be either positive or negative, we can conclude that there exist parameter configurations such that

$$\left.\frac{\partial^2 W_i}{\partial t_i^2}\right|_{t_i=t_j} < 0,$$

implying that $t^*(\delta_i, \delta_j, \alpha, \tau) \equiv t_i = t_j$ is a local Nash equilibrium of the tax competition stage.

To show that such a symmetric equilibrium tax rate is positive for all possible values of $\alpha \in [0,1]$ and $\tau \in \left[0, \frac{1}{2}\right)$, as long as $\delta_i, \delta_j > 0$, we need to check the sign of the following expression

$$f(\alpha, \tau) \equiv 5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2,$$

which is strictly decreasing in α, since $\partial f(\alpha,\tau)/\partial\alpha = -(1+\tau)^2 < 0, \forall\tau$. Then, we can restrict our attention to the maximum value which α can take, i.e. $\alpha = 1$, which gives

$$f(1,\tau) = (2\tau-1)^2 > 0, \quad \forall\tau \in \left[0, \frac{1}{2}\right).$$

Therefore, since $f(1,\tau) > 0,\ \forall\tau$, and $f(\alpha,\tau)$ is strictly decreasing in α, we can conclude that $f(\alpha,\tau) > 0$ for all $\alpha \in [0,1]$, implying that $t^*(\delta_i,\delta_j,\alpha,\tau)$ is positive for all possible values of α and τ.

Proof of Proposition 1

The effects on t^* of a change in the level of enforcement of the "arm's length" principle by country i, by country j or by both countries are reflected by

$$\begin{aligned}
\frac{\partial t^*}{\partial \delta_i} &= \frac{2\delta_j^2\left[5\tau^2-2\tau+2-\alpha(1+\tau)^2\right]}{3(1-2\tau)(\delta_i+\delta_j)^2} > 0, \text{ as long as } \delta_j > 0,\\
\frac{\partial t^*}{\partial \delta_j} &= \frac{2\delta_i^2\left[5\tau^2-2\tau+2-\alpha(1+\tau)^2\right]}{3(1-2\tau)(\delta_i+\delta_j)^2} > 0, \text{ as long as } \delta_i > 0,\\
\frac{\partial t^*}{\partial \delta_i \partial \delta_j} &= \frac{4\delta_i\delta_j\left[5\tau^2-2\tau+2-\alpha(1+\tau)^2\right]}{3(1-2\tau)(\delta_i+\delta_j)^3} > 0, \text{ as long as } \delta_i,\delta_j > 0,
\end{aligned}$$

which allow us to conclude that an increase in the enforcement policy by one of the two - or by both - countries will increase t^*.

Proof of Proposition 2

The effect on t^* of a change in the ownership structure of MNEs is given by

$$\frac{\partial t^*}{\partial \alpha} = -\frac{2\delta_i\delta_j(1+\tau)^2}{3(1-2\tau)(\delta_i+\delta_j)} < 0, \text{ as long as } \delta_i,\delta_j > 0,$$

so that we can argue that a lower α will increase t^*.

Trade liberalization: *Direct* vs *TP* effect

In the case of full domestic ownership ($\alpha = 1$), direct and TP effects are given by

$$e(\tau) = \frac{(1-2\tau)^2}{9} \quad \text{and} \quad g(\tau) = -\frac{t^*(\delta_i+\delta_j)(1-2\tau)}{6\delta_i\delta_j},$$

respectively. Differentiating $e(\tau)$ with respect to τ, we find that

$$\frac{\partial e(\tau)}{\partial \tau} > 0 \Leftrightarrow \tau > \frac{1}{2}.$$

Hence, $\partial e(\tau)/\partial\tau < 0,\ \forall\tau \in \left[0, \frac{1}{2}\right)$, meaning that the impact of trade liberalization on the direct effect is positive. On the contrary, differentiating $g(\tau)$ with respect to τ, we have

that $\partial g(\tau)/\partial\tau > 0,\ \forall\tau \in \left[0, \frac{1}{2}\right)$, and this implies that the impact of trade liberalization on the TP effect is negative.

In the case of full third-country ownership ($\alpha = 0$), the TP effect and the impact on it of a decrease in trade costs are the same as above, while the direct effect is equal to

$$h(\tau) = \frac{(1-2\tau)^2}{9} + \frac{(1+\tau)^2}{9}.$$

Differentiating $h(\tau)$ with respect to τ, we find that

$$\frac{\partial h(\tau)}{\partial\tau} > 0 \Leftrightarrow \tau > \frac{1}{5}.$$

Furthermore, since $\partial^2 h(\tau)/\partial\tau^2 > 0$, we have that $h(\tau)$ is a strictly convex function which reaches its minimum value at $\tau = \frac{1}{5}$. Thus, trade liberalization has a non-monotonic impact on the direct effect. For $\tau \in \left[0, \frac{1}{5}\right)$, $\partial h(\tau)/\partial\tau < 0$, meaning that such an impact is positive just for sufficiently low values of trade costs. Instead, $\partial h(\tau)/\partial\tau > 0$ for $\tau \in \left(\frac{1}{5}, \frac{1}{2}\right)$, implying that for higher values of trade costs trade liberalization has a negative impact on the direct effect as well.

Proof of Proposition 3

(i) In the case of full domestic ownership ($\alpha = 1$), the symmetric equilibrium tax rate is given by

$$t^*(\delta_i, \delta_j, 1, \tau) = \frac{2\delta_i\delta_j(1-2\tau)}{3(\delta_i+\delta_j)},$$

and the effect on it of a change in trade costs is captured by

$$\frac{\partial t^*(\delta_i, \delta_j, 1, \tau)}{\partial\tau} = -\frac{4\delta_i\delta_j}{3(\delta_i+\delta_j)} < 0,$$

which allows us to conclude that a decrease in τ increases t^*.
(ii) In the case of full third-country ownership ($\alpha = 0$), the symmetric equilibrium tax rate is given by

$$t^*(\delta_i, \delta_j, 0, \tau) = \frac{2\delta_i\delta_j\left(5\tau^2 - 2\tau + 2\right)}{3(\delta_i+\delta_j)(1-2\tau)},$$

and the effect on it of a change in trade costs is captured by

$$\frac{\partial t^*(\delta_i, \delta_j, 0, \tau)}{\partial\tau} = \frac{4\delta_i\delta_j\left(1+5\tau-5\tau^2\right)}{3(\delta_i+\delta_j)(1-2\tau)^2} > 0,$$

implying that a decrease in τ decreases t^*.
(iii) and (iv) The sign of $\partial t^*/\partial\tau$ for values of $\alpha \in (0,1)$ only depends on the sign of the following expression

$$l(\alpha, \tau) \equiv 1 + 5\tau - 5\tau^2 - \alpha(1+\tau)(2-\tau).$$

In particular, $l(\alpha, \tau) > 0$ for all values of τ satisfying

$$(5-\alpha)\tau^2 - (5-\alpha)\tau + 2\alpha - 1 < 0,$$

that is for all $\tau \in (\hat{\tau}, \tilde{\tau})$, where

$$\hat{\tau} = \frac{1}{2} - \frac{3\sqrt{(5-\alpha)(1-\alpha)}}{2(5-\alpha)}$$

and

$$\tilde{\tau} = \frac{1}{2} + \frac{3\sqrt{(5-\alpha)(1-\alpha)}}{2(5-\alpha)}.$$

Since $\alpha \in [0,1]$, we can easily check that $\tilde{\tau} \geq \frac{1}{2}$. Moreover, $\hat{\tau} > 0$ as long as $\alpha > \frac{1}{2}$. Therefore, given our assumption about trade costs, we can conclude that

- for $\alpha \leq \frac{1}{2}$, $\hat{\tau} \leq 0$ and $\tilde{\tau} \geq \frac{1}{2}$, implying that $l(\alpha, \tau) > 0$ for all $\tau \in \left[0, \frac{1}{2}\right)$; this means that $\partial t^*/\partial \tau > 0$, i.e. trade liberalization leads to a decrease in the symmetric equilibrium tax rate;
- for $\alpha > \frac{1}{2}$, $\hat{\tau} > 0$ and $\tilde{\tau} \geq \frac{1}{2}$; this implies that $l(\alpha, \tau)$ and $\partial t^*/\partial \tau$ are positive for $\tau \in \left(\hat{\tau}, \frac{1}{2}\right)$, but they are negative for $\tau \in [0, \hat{\tau}]$; thus, if domestic residents hold the majority of shares in both MNEs, the relationship between τ and t^* is non-monotonic and trade liberalization increases the symmetric equilibrium tax rate for sufficiently low values of τ.

Appendix A2: Enforcement policy competition

Economic integration and the *Indirect* effect

The indirect effect on country i's national welfare of a change in the level of enforcement of the "arm's length" principle is given by

$$k(\alpha, \tau) = \frac{2\delta_j^2 (1-\alpha)\left(5\tau^2 - 2\tau + 2\right)\left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right]}{27(1-2\tau)(\delta_i + \delta_j)^2}.$$

To see how the ownership structure of MNEs affects such an indirect effect, we derive the following expression

$$\frac{\partial k(\alpha, \tau)}{\partial \alpha} = -\frac{2\delta_j^2\left(5\tau^2 - 2\tau + 2\right)\left[5\tau^2 - 2\tau + 2 + (1-2\alpha)(1+\tau)^2\right]}{27(1-2\tau)(\delta_i + \delta_j)^2} < 0,$$

as long as $\delta_j > 0$. A decrease in the domestic ownership share of MNEs increases the positive indirect effect, thus the benefits - in terms of national welfare - to enforce the "arm's length" principle.

With full third-country ownership ($\alpha = 0$), the indirect effect reduces to

$$k(0, \tau) = \frac{2\delta_j^2\left(5\tau^2 - 2\tau + 2\right)^2}{27(1-2\tau)(\delta_i + \delta_j)^2},$$

and the impact of a change in trade costs is captured by

$$\frac{\partial k(0, \tau)}{\partial \tau} = \frac{4\delta_j^2 \tau(4 - 5\tau)\left(5\tau^2 - 2\tau + 2\right)}{9(1-2\tau)^2(\delta_i + \delta_j)^2} > 0, \ \forall \tau \in \left[0, \frac{1}{2}\right).$$

Therefore, when both MNEs are fully owned by third-country residents, trade liberalization decreases the positive indirect effect of the enforcement policy on national welfare.

Existence of the symmetric equilibrium in enforcement policies

To prove such a result, we first need to show that the objective function of country i (country j) identified in Section 5 is concave in δ_i (δ_j). This amounts to check the sign of the following second derivatives

$$\begin{aligned}
\frac{\partial^2 W_i^*}{\partial \delta_i^2} &= -\frac{4\left(1-\alpha\right)\left(5\tau^2-2\tau+2\right)\left[5\tau^2-2\tau+2-\alpha\left(1+\tau\right)^2\right]\delta_j^2}{27\left(1-2\tau\right)\left(\delta_i+\delta_j\right)^3}-d, \\
\frac{\partial^2 W_j^*}{\partial \delta_j^2} &= -\frac{4\left(1-\alpha\right)\left(5\tau^2-2\tau+2\right)\left[5\tau^2-2\tau+2-\alpha\left(1+\tau\right)^2\right]\delta_i^2}{27\left(1-2\tau\right)\left(\delta_i+\delta_j\right)^3}-d.
\end{aligned}$$

Since $d>0$ by assumption and we have shown above that the term in square brackets - $f(\alpha,\tau)$ - is always positive, both derivatives turn out to be negative for all possible values of δ_i, δ_j, α and τ. Hence, the objective function of country i (country j) is concave in its own argument.

The first-order conditions for the maximization problem of the two governments are

$$\begin{cases}
\frac{(1-\alpha)\left(5\tau^2-2\tau+2\right)}{9}\frac{\partial t^*}{\partial \delta_i}-d\delta_i=0 \\
\\
\frac{(1-\alpha)\left(5\tau^2-2\tau+2\right)}{9}\frac{\partial t^*}{\partial \delta_j}-d\delta_j=0
\end{cases}$$

Substituting for $\partial t^*/\partial\delta_i$ and $\partial t^*/\partial\delta_j$ and rearranging, we get the following system

$$\begin{cases}
\frac{2(1-\alpha)\left(5\tau^2-2\tau+2\right)\left[5\tau^2-2\tau+2-\alpha(1+\tau)^2\right]}{27d(1-2\tau)(\delta_i+\delta_j)^2} &= \frac{\delta_i}{\delta_j^2} \\
\\
\frac{2(1-\alpha)\left(5\tau^2-2\tau+2\right)\left[5\tau^2-2\tau+2-\alpha(1+\tau)^2\right]}{27d(1-2\tau)(\delta_i+\delta_j)^2} &= \frac{\delta_j}{\delta_i^2}
\end{cases}$$

which implies

$$\frac{\delta_i}{\delta_j^2}=\frac{\delta_j}{\delta_i^2},$$

so that

$$\delta_i^3=\delta_j^3 \Longleftrightarrow \delta_i=\delta_j,$$

i.e. there exists a symmetric equilibrium $\delta^* \equiv \delta_i=\delta_j$ in transfer pricing enforcement policies.

Proof of Proposition 6

To prove the negative relationship between the ownership structure parameter, α, and the equilibrium level of enforcement of the "arm's length" principle, δ^*, we need to show that the function

$$m\left(\alpha,\tau\right) \equiv 5\tau^2-2\tau+2+(1+\tau^2)(1-2\alpha)$$

is positive for all admissible values of α and τ. Since $\partial m(\alpha,\tau)/\partial\alpha = -2\tau^2 - 2 < 0, \forall\tau$, we have that $m(\alpha,\tau)$ is strictly decreasing in α. Then, we restrict our attention to the maximum value which α can take, i.e. $\alpha = 1$, which gives

$$m(1,\tau) = 4\tau^2 - 2\tau + 1 > 0, \quad \forall\tau \in \left[0, \frac{1}{2}\right).$$

Therefore, since $m(1,\tau) > 0,\ \forall\tau$, and $m(\alpha,\tau)$ is strictly decreasing in α, we can conclude that $m(\alpha,\tau) > 0$ for all $\alpha \in [0,1]$, implying that $\partial\delta^*/\partial\alpha < 0$ for all possible values of α and τ.

With full third-country ownership ($\alpha = 0$), the symmetric equilibrium level of enforcement reduces to

$$\delta^*(0,\tau) = \frac{\left(5\tau^2 - 2\tau + 2\right)^2}{54d(1-2\tau)} > 0,$$

and the effect on it of a change in trade costs is captured by

$$\frac{\partial\delta^*(0,\tau)}{\partial\tau} = \frac{\tau(4-5\tau)\left(5\tau^2 - 2\tau + 2\right)}{9d(1-2\tau)^2} > 0,\ \forall\tau \in \left[0, \frac{1}{2}\right),$$

meaning that trade liberalization decreases $\delta^*(0,\tau)$.

To analyze the relationship between trade liberalization and the symmetric equilibrium level of enforcement for values of $\alpha \in (0,1)$, we need to check the sign of

$$\begin{aligned}\frac{\partial\delta^*(\alpha,\tau)}{\partial\tau} &= \frac{1-\alpha}{27d(1-2\tau)^2}\Big\{(1-2\tau)(5\tau-1)\left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right] \\ &+ (1-2\tau)\left(5\tau^2 - 2\tau + 2\right)[5\tau - 1 - \alpha(1+\tau)] \\ &+ \left(5\tau^2 - 2\tau + 2\right)\left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right]\Big\}.\end{aligned}$$

Since $(1-\alpha)/27d(1-2\tau)^2 > 0$ for all values of $\alpha \in (0,1)$ and $\tau \in \left[0, \frac{1}{2}\right)$, we have that $\partial\delta^*(\alpha,\tau)/\partial\tau > 0$ as long as the term in braces is positive. Hence, we need to show that

$$\begin{aligned}r(\alpha,\tau) &\equiv \left[5\tau^2 - 2\tau + 2 - \alpha(1+\tau)^2\right]\left[(1-2\tau)(5\tau-1) + \left(5\tau^2 - 2\tau + 2\right)\right] \\ &+ (1-2\tau)\left(5\tau^2 - 2\tau + 2\right)[5\tau - 1 - \alpha(1+\tau)] > 0.\end{aligned}$$

The last inequality holds for all values of α such that

$$\alpha < \hat{\alpha}(\tau) \equiv \frac{\tau\left(5\tau^2 - 2\tau + 2\right)(4-5\tau)}{(1+\tau)(1+3\tau^2-5\tau^3)},$$

where $\hat{\alpha}(\tau)$ represents the threshold value above which trade liberalization leads to an increase in the equilibrium enforcement policy. Furthermore, $\partial\hat{\alpha}(\tau)/\partial\tau > 0,\ \forall\tau \in \left[0, \frac{1}{2}\right)$, meaning that as τ decreases, the threshold value for α decreases as well.

In other words, when trade costs become sufficiently low, trade liberalization may increase the equilibrium level of enforcement of the "arm's length" principle, depending on the ownership structure of MNEs as represented by α.

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