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Abstract

When countries compete for the location of a new multinational plant they need to be aware of the profit shifting opportunities this new plant creates for the global multinational firm. By modelling explicitly the multinational's intra-firm transactions, we show that the home market advantage that large countries have due to their size will be counteracted by such profit shifting opportunities. As a result of this, large countries will not be able to capitalize on their size and sustain high corporate taxes. We show that, on the basis of these profit shifting opportunities, a small country can easily win the location game ahead of a large country. How lenient the small country is in implementing transfer pricing regulations turns out to be an important variable in such location games.

JEL-Code: H250, F230.

Keywords: profit shifting, competition for FDI, location game.

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1. INTRODUCTION

As recently as June 2014 the EU antitrust authorities announced a formal investigation of the tax agreements Ireland, Luxembourg, and Holland made with Apple, Starbucks, and Fiat, respectively. The EU authorities argued that the Advanced Pricing Agreements (APA) that the countries signed with the above firms may be breaching EU's state-aid law. The countries' reaction was that they had done nothing illegal; advanced pricing agreements are contracts that countries and firms can rightfully design as they deem fit.[1] While time will show whether state-aid law was violated by those APAs, it is interesting to note that in the same time period a leak within PricewaterhouseCoopers (PwC), Luxembourg, supplied hundreds of APA contracts to the media, who on November 6, 2014 planned a coordinated campaign across Europe exposing the agreements tax authorities and multinational firms make.[2] The overall sentiment is clearly that such cases exemplify the situation we are standing in: multinationals having the upper hand when making individual taxing deals with tax authorities. The fact that these deals involve an APA, i.e. a contract between the MNE and the country's tax authority that determines *future* taxing arrangements, makes it an even more compelling example for the tax competition game we want to address, viz. a location game that takes into account profit shifting opportunities.

There is of course an extensive literature on competing for MNE's location and profits; see Gresik (2001) and, more recently, Keen and Konrad (2013) for comprehensive surveys. However, as Keen and Konrad (2013) point out, tax competition occurs at two different stages of the game — viz. prior to the entry of the MNE, where countries compete for its location, and after the entry of the MNE, where countries compete for its profits — and each stage has been addressed separately in the literature: while the *'competing for the location of a MNE'* literature assumes no profit shifting and focuses on extensive margin tax-base issues, the *'competing for profits'* literature assumes fixed location and focuses on intensive margin tax-base issues. We wish to address both margins within the same model and thereby endogenize the profit shifting behavior when location decisions are made.

Our model will describe a situation where countries compete for the location of a new MNE that is very much aware of the profit shifting opportunities that open up by its location decision. The story that we have in mind is the following. When a MNE, say from the USA, considers to locate a production facility in a region, say the EU, it will have to decide in which country

[1] See http://online.wsj.com/articles/eu-to-probe-tax-affairs-of-apple-starbucks-1402476699.
[2] See http://www.icij.org/project/luxembourg-leaks/lux-leaks-revelations-bring-swift-response-around-world.

within that region to make the investment. Assume that there are two countries; a small one and a large one. By locating its production activities in one country the MNE will have to transport its goods to the other country at costs. Due to this costly trade, the large country will have a home market advantage, i.e. its size makes it advantageous for a firm to locate there in order to save transportation costs. As a result of this location advantage, the 'competing for the location of a MNE' literature (see, e.g. Haufler and Wooton, 1999) concludes that the large country will be able to tax the MNE and attract it within its borders. However, what has not been taken into account is that by locating in the, say, high-tax large country, the MNE foregoes profit shifting opportunities with respect to its activities in the USA where corporate taxes are the highest in the world. Indeed, if the MNE had chosen to locate in the low-tax small country, the profit shifting opportunities with respect to its USA activities might have been larger than the profit shifting opportunities that it has by locating in the high-tax large country. Hence, the home market effect may be counteracted by the profit shifting opportunities that the MNE creates upon its location.

By introducing profit shifting opportunities into a 'competing for the location of a MNE' setup, the small country may use this profit shifting mechanism to counteract the home market advantage the large country has. A MNE with a parent firm located in a high-tax country will value these profit shifting opportunities that the small country provides. Whether these opportunities are sufficient to overturn the home market advantage of the large country will depend on a number of issues. One of the issues will be the leniency that the small country shows toward implementing tax regulations; something that connects to the example presented in the opening paragraph and to the burgeoning tax haven literature (see Desai et al., 1996).

The profit shifting mechanism that we introduce in this paper is, to our knowledge, novel to the location competition literature. Since the establishment of the large country's home market advantage by Haufler and Wooton (1999), a series of papers focused on what other forces (than market size) may affect the bidding for a MNE. While Barros and Cabral (2000) emphasize the employment creation effect, Fumagalli (2003) emphasizes the technological spillover effect and Bjorvatn and Eckel (2006) emphasize the competition effect that the entry of MNEs may bring in. Moreover, MNEs may launch overseas production plants in order to control strategic inputs. Competition for this kind of FDI is examined in Ma (2013).[3] In contrast to this literature the

[3]There are several other papers that look at an asymmetric tax competition game for foreign direct investment; see e.g. Kind et al. (2000), Ludema and Wooton (2000), Baldwin and Krugman (2004), Raff (2004), Stöwhasse

present paper does not introduce a new feature of the economy (e.g. unemployment, technology spillovers, competition and so forth) in order to counteract the size advantage that large countries have. We argue that *within* the original Haufler and Wooton (1999) model there is mechanism that makes it possible for the small economy to win the location game, viz. profit shifting. To show this, we adopt exactly the same model as in Haufler and Wooton (1999) but now we explicitly model the parent MNE that decides where to place its new subsidiary.[4]

The rest of the paper is organized as follows. Section 2 presents the framework and section 3 solves for the decisions that the MNE makes on the basis of the taxes that it faces. We endogenize the taxes in section 4 and we offer some concluding remarks in section 5.

2. The Framework

Consider a MNE from country H that wants to serve a region with two countries, A and B, that differ in population size. We label country A as small and country B as large. Such an asymmetry is depicted in the demand function that the MNE faces in each country; while the (inverse) demand function in country A is $p_A = 1 - Q_A$, the (inverse) demand function in country B is $p_B = 1 - \frac{1}{N} Q_B$. Thus, total demand in country B is N times larger than total demand in country A.

Focusing on the FDI entry mode for serving the region, we close down the possibility that the parent MNE serves the region's demands with direct exports from country H.[5] The multinational firm has thus two options: establish a production plant in A and export to B, or establish a production plant in B and export to A. It is assumed that exporting one unit of the product from one country to the other incurs a per unit transport cost $\tau \in [0, 1]$. We abstract from other reasons that could make the MNE locate in a particular country by assuming that production costs are similar across all countries. To simplify the analysis, the (constant) marginal costs and the fixed costs are both set to zero.

(2005, 2013), Peralta and van Ypersele (2005), Peralta et al. (2006), Behrens and Picard (2008), Bucovetsky and Haufler (2008), Haufler and Wooton (2010), Lai (2010), Krautheim and Schmidt-Eisenlohr (2011), Kato (2014).

[4] Amerighi and Peralta (2010) also combine profit shifting and the entry choice of a MNE. However, the focal point of their analysis is whether the MNE will enter multiple countries or not. If it enters multiple countries, the MNE opens up the possibility of profit shifting between the host countries (i.e. no profit shifting with the parent firm). If it enters one country and exports to the rest the MNE saves the fixed costs associated with new plants but it also loses the profit shifting opportunities that many plants entail. The level of (exogenous) taxes and the size of the fixed costs determine the optimal choice of the MNE; indeed, a proximity-concentration trade-off. The present paper endogenizes the tax choices governments make and allows profit shifting between the parent firm and its upcoming subsidiary; there is no need of introducing multiple locations to give power to the profit shifting mechanism.

[5] Endogenizing the entry mode into the region will make profit shifting a reason for making a new investment. Such a result resembles the contributions of Amerighi and Peralta (2010) and is therefore not pursued here.

All the above is as in the Haufler and Wooton (1999) paper. Deviating from it, we now introduce the parent MNE and its transaction with its subsidiary. In general MNEs have internal markets where goods and services are traded using transfer prices. Since such internal markets are not exposed to market forces, transfer prices are solely controlled by the global MNE.[6] We assume that transfer prices are used to minimize global tax payments.[7]

The internal trade between the parent and the subsidiary is about an intermediate input. For our purpose it suffices to assume that producing one unit of the product in the subsidiary requires one unit of an intermediate good shipped by the parent. The (transfer) price of that intermediate input is depicted by q_i, $i \in \{A, B\}$. Since the marginal cost of production is normalized to zero, the true price of this intermediate good is also zero. Any transfer price that is different from zero will then depict either overpricing (if $q_i > 0$) or underpricing (if $q_i < 0$). Deviating, however, from the true price has to be explained and documented to tax authorities and that entails costs to the MNE. We assume that these costs are quadratic and depend on the distance from the true price, i.e. $\frac{\gamma_i}{2}(q_i - MC)^2 = \frac{\gamma_i}{2}{q_i}^2$, where $\gamma_i \in [0, 1]$ denotes a parameter that represents how lenient tax authorities are in implementing tax regulations.[8]

Finally, countries employ an ad valorem corporate income tax rate $t_i, i \in \{A, B, H\}$. We assume that countries A and B choose their optimal tax rates in a non-cooperative fashion. To focus on the location game, we keep t_H fixed.

The timing of the game is the following:

- Stage 0: Countries A and B choose their tax rates simultaneously in a Nash game.
- Stage 1: The MNE decides whether to locate its subsidiary in country A or B.

[6] In principle MNEs do not perfectly control transfer prices as there are rules that governments use for assessing what the 'right' transfer prices should be. Such transfer pricing rules are designed on the basis of the arm's length principle that OECD works with. However, it is widely accepted that such rules are both insufficient for restricting the profit shifting behavior of MNEs and distortive in different ways; see Elitzur and Mintz (1996), and Raimondos-Møller and Scharf (2002). In the present paper we allow the MNE to control the transfer price knowing that there are costs associated with such behavior.

[7] Of course, transfer prices can also be used for other purposes, e.g. providing incentives to subsidiaries. There is a growing literature that addresses the use of transfer prices for multiple objectives and whether these objectives come in conflict with each other; see Hyde and Choe (2005), and Nielsen and Raimondos-Møller (2012).

[8] These transfer pricing costs can be resources that the MNE spends on employing accounting firms that specialize in transfer pricing documentation around the world. The higher the deviation from the true price, the larger the resources that the MNE has to spend on accounting firms. Nielsen et al. (2010) consider microfounded specifications for transfer pricing costs based on probabilities of being caught and related penalties. For our purpose it suffices to use the quadratic transfer pricing cost function augmented with the parameter γ_i. The latter should capture the fact that some tax authorities do not require large documentation for transfer price choices (γ_i being close to zero).

- Stage 2: The MNE decides centrally its transfer price, the final prices and sales.[9]

We proceed by solving the model backward. We solve for all the endogenous variables assuming that the MNE chooses country A and we then do the same assuming that the MNE chooses country B. We then compare profits and determine the equilibrium location. Having that in place, we then go back a step and determine the Nash taxes.

3. The Location Decision

Taking taxes as given the MNE will decide where to locate and how much to sell in each country. Subsection 3.1 looks these latter choices assuming that the MNE locates in country A. Subsection 3.2 will do the same assuming that the MNE locates in country B. The comparison and, thus, the location choice will be derived in subsection 3.3.

3.1. FDI in country A**.** The multinational firm's after-tax global profits, π^A, consist of after-tax operating profits made in the region plus the after-tax profit shifting component.[10] With transfer pricing costs not being tax deductible, total after-tax profits can be written as:

$$\pi^A = (1-t_A)\left[\left(1-Q_A^A\right)Q_A^A + \left(1-\frac{1}{N}Q_B^A - \tau\right)Q_B^A\right] + (t_A - t_H)\left[q_A\left(Q_A^A + Q_B^A\right)\right] - \frac{\gamma_A q_A^2}{2}, \quad (1)$$

where Q_i^j denotes sales in country i from location j, for $i, j = A, B$.

Maximizing (1) with respect to Q_A^A, Q_B^A and q_A gives:

$$Q_A^A \quad : \quad Q_A^A = \frac{(1-t_A) + (t_A - t_H)\, q_A}{2\,(1-t_A)}, \quad (2)$$

$$Q_B^A \quad : \quad Q_B^A = \frac{N\left[(1-t_A)(1-\tau) + (t_A - t_H)\, q_A\right]}{2\,(1-t_A)}, \quad (3)$$

$$q_A \quad : \quad \gamma_A q_A = (t_A - t_H)\left(Q_A^A + Q_B^A\right). \quad (4)$$

From (4) we note that, as expected, the *sign* of the transfer price q_A is solely determined by the tax differential $t_A - t_H$. To see this note that if the tax in the home country is higher than the tax in the host country, the MNE will have an incentive to move profits away from the

[9] One could consider a decentralized decision process, where the parent determines the transfer price while the subsidiary determines the final prices and sales (taking transfer prices as given). Such a delegation of power is better for the MNE if the subsidiary faces competition in its local market — see Schjelderup and Søgaard (1997), and Nielsen et al. (2008). However, in our current setup (with the MNE having monopoly power) it can be shown that a decentralized structure will never be optimal.

[10] The parent MNE makes profits also by selling in the home country and other markets. But since we assume that these sales are not affected by sales in the host region, we can simply abstract from them in our analysis.

home country into the host country. The way to do that is by underpricing the intermediate input, i.e. by charging a price lower than marginal costs of production. Since these costs have been set to zero, underpricing amounts here to a negative transfer price, i.e. a subsidy. If the home country has lower taxes than the host country has, then the optimal transfer price will be positive and profits will be moved from the host country to the home country. We can thus write:

$$sign\ (t_A - t_H) = sign\ (q_A).$$

From (4) we also note that besides the size of tax differential, the *size* of the transfer price is affected by both the coefficient of transfer pricing costs and the size of the intra-firm trade. On the one hand, the smaller the coefficient of transfer pricing costs, the bigger the absolute value of the transfer price. On the other hand, the higher the sales in the region, the higher the incentive for the MNE to engage in profit shifting. In turn, given that transfer pricing costs are assumed not to be proportional to the intra-firm trade, this increased benefit from profit shifting will translate into more aggressive transfer pricing, i.e. larger deviations from the true price.[11]

Substituting (2) and (3) into (4) and rearranging gives:

$$q_A = \frac{(1-t_A)(t_A-t_H)(1+N(1-\tau))}{2\gamma_A(1-t_A)-(N+1)(t_A-t_H)^2}. \tag{5}$$

From the second-order condition for profit maximization we establish that the denominator of the above expression is positive, $2\gamma_A(1-t_A)-(N+1)(t_A-t_H)^2 > 0$.[12]

Instead of solving for the explicit values for Q_A^A and Q_B^A and substituting them back into the profit function, we note that from (2) we can write:

$$\begin{aligned} 1-Q_A^A &= \frac{(1-t_A)-(t_A-t_H)\,q_A}{2(1-t_A)} \Longrightarrow \\ \left(1-Q_A^A\right)Q_A^A &= \frac{(1-t_A)^2-(t_A-t_H)^2\,q_A^2}{4(1-t_A)^2}. \end{aligned}$$

[11]It is easy to show that transfer prices will be independent of the sales size if, and only if, the cost of transfer pricing is proportional to the size of the intra-firm shipment, e.g. $\frac{1}{2}(Q_i^i+Q_j^i)q_i^2$. Such a result provides an insight into the importance of designing optimal transfer pricing penalties; see Nielsen (2014) and Nielsen et al. (2014).

[12]See Appendix 1.

Similarly, from (3) we can write:

$$
\begin{aligned}
1-\frac{1}{N}Q_B^A-\tau &= \frac{(1-t_A)(1-\tau)-(t_A-t_H)\,q_A}{2(1-t_A)} \Longrightarrow \\
\left(1-\frac{1}{N}Q_B^A-\tau\right)Q_B^A &= \frac{N\left[(1-t_A)^2(1-\tau)^2-(t_A-t_H)^2 q_A^2\right]}{4(1-t_A)^2}.
\end{aligned}
$$

Using these expressions together with (4) we can then rewrite (1) as:

$$
\pi^A = \frac{1-t_A}{4}\left[1+N(1-\tau)^2+\frac{(t_A-t_H)^2(1+N(1-\tau))^2}{2\gamma_A(1-t_A)-(N+1)(t_A-t_H)^2}\right]. \tag{6}
$$

While the first term in the above expression represents the after-tax profits from locating in country A and exporting to country B, the second term represents the profits from transfer pricing, i.e. when $t_A-t_H\neq 0$. Note that the sign of the tax differential is not important; profit shifting will always increase global profits.

3.2. FDI in country B. If instead the MNE decides to locate in country B, then after-tax global profits, π^B, will be:

$$
\pi^B=(1-t_B)\left[\left(1-Q_A^B-\tau\right)Q_A^B+\left(1-\frac{1}{N}Q_B^B\right)Q_B^B\right]+(t_B-t_H)\left[q_B\left(Q_A^B+Q_B^B\right)\right]-\frac{\gamma_B q_B^2}{2}. \tag{7}
$$

The first-order conditions for profit maximization with respect to Q_A^B, Q_B^B, and q_B will then give:

$$
Q_A^B \quad : \quad Q_A^B=\frac{(1-t_B)(1-\tau)+(t_B-t_H)\,q_B}{2(1-t_B)}, \tag{8}
$$

$$
Q_B^B \quad : \quad Q_B^B=\frac{N\left[(1-t_B)+(t_B-t_H)\,q_B\right]}{2(1-t_B)}, \tag{9}
$$

$$
q_B \quad : \quad \gamma_B q_B=(t_B-t_H)\left(Q_A^B+Q_B^B\right). \tag{10}
$$

Solving for the transfer price we get:

$$
q_B=\frac{(1-t_B)(t_B-t_H)(N+1-\tau)}{2\gamma_B(1-t_B)-(N+1)(t_B-t_H)^2}, \tag{11}
$$

where again the denominator is positive to satisfy the second-order condition for profit maximization, $2\gamma_B(1-t_B)-(N+1)(t_B-t_H)^2>0$. The properties of the transfer price if the MNE decides to locate in country B are similar to those that we derived previously and thus will not be repeated here.

Finally, rewriting the profit function in a similar fashion as in the previous subsection, we have:

$$\pi^B = \frac{1-t_B}{4}\left[N + (1-\tau)^2 + \frac{(t_B - t_H)^2 (N+1-\tau)^2}{2\gamma_B (1-t_B) - (N+1)(t_B - t_H)^2}\right]. \tag{12}$$

As in subsection 3.1, the first term represents the after-tax profits from locating in country B and exporting to country A, and the second term represents the profits from transfer pricing, i.e. when $t_B - t_H \neq 0$.

3.3. Comparing locations A and B . Comparing expressions (5) and (11) we see that, other things equal, the MNE will choose a more aggressive transfer price if it locates in the large country, i.e.:

$$t_A = t_B \neq t_H,\ \gamma_A = \gamma_B \Longrightarrow |q_B| > |q_A|.$$

The intuition for this builds on the above described property of transfer prices, i.e. that the transfer price depends on the size of the transaction. When the only asymmetry is **in** country size, the MNE will locate in the large country and will sell more, i.e. $Q_A^B + Q_B^B > Q_A^A + Q_B^A$. The higher the sales it makes, the higher the intra-firm transactions between the subsidiary and its parent company and, thus, the higher the benefits from transfer pricing. With the costs of transfer pricing not being proportional to the intra-firm transactions, this translates into a more aggressive transfer pricing practice. The following proposition formalizes this.

Proposition 1. *Other things being equal, locating in a larger country induces the MNE to choose a more aggressive transfer pricing practice than locating in a small country.*

The implications of this result should be clear: a more aggressive transfer pricing behavior will clearly act as a dampening for the location advantage that the large country has. The large country will not be able to capitalize on its home market advantage, e.g. by raising its taxes, as it would in the absence of transfer pricing.

To see how the two effects (home market and profit shifting) affect the MNE's location decision, we compare profit levels in (6) and (12). For easiness, we reproduce them below:

$$\begin{aligned}
\pi_A &= \frac{1-t_A}{4}\left[1 + N(1-\tau)^2 + \frac{(t_A - t_H)^2 (1+N(1-\tau))^2}{2\gamma_A (1-t_A) - (N+1)(t_A - t_H)^2}\right], \\
\pi_B &= \frac{1-t_B}{4}\left[N + (1-\tau)^2 + \frac{(t_B - t_H)^2 (N+1-\tau)^2}{2\gamma_B (1-t_B) - (N+1)(t_B - t_H)^2}\right].
\end{aligned}$$

Except t_A and t_B (that are determined at stage 0 of the game) all other variables N, t_H, γ_i, τ are parameters of the model.

We consider different cases.

#1 Consider first the case where there are no profit shifting opportunities, i.e. $t_i = t_H$. This is the case in Haufler and Wooton (1999), who do not model the parent MNE and its profit shifting opportunity.[13] In that case the profit comparison is straightforward. By removing the second term in the profit expressions we end up comparing only the first effects, which will be higher in the large country, i.e. $\pi_B > \pi_A$.[14] Thus, the MNE prefers locating in the large country due to the home market effect.

#2 Consider now the case where profit shifting opportunities exist but are equal across potential host countries, i.e. $t_H \neq t_A = t_B$. If we assume that the two countries have the same transfer pricing cost functions, i.e. $\gamma_A = \gamma_B$, then again it is straightforward to conclude that the profits in the large country are larger than the profits in the small country ($\pi_B > \pi_A$).[15] However, this can change if an asymmetry is introduced on how lenient that tax authorities are. Assume for example that the small country is more lenient in transfer pricing documentation rules than the large country is, i.e. $\gamma_A < \gamma_B$. In that case, even if tax rates are the same across host countries, the profit shifting effect induced by a lower transfer pricing cost in the small country can make profits in the small country larger than profits in the large country. In this sense, lenient transfer pricing documentation rules in a small country can turn out to be pivotal when MNEs decide where to locate.[16]

#3 Consider finally the case where all taxes are different, i.e. $t_H \neq t_A \neq t_B$. Assume that the home country has the highest tax among all countries, i.e. $t_H > t_i$, and that there is symmetry in transfer pricing cost functions, i.e. $\gamma_A = \gamma_B$.[17]

---

[13] Haufler and Wooton (1999) consider lump-sum taxes rather than ad valorem taxes. This allows them to derive slightly different expressions, but the main thrust of the arguments is the same.

[14] This is because $N + 1 - \tau > 1 + N(1 - \tau)$ is always true when $N > 1$ and $0 < \tau < 1$.

[15] This is because the second term in π^B will also be larger than the second term in π^A.

[16] The present paper treats γ_i as exogenous, i.e. host countries do not choose how lenient their transfer pricing documentation rules should be. As mentioned previously, there is no work on optimal design of transfer pricing penalties and thereby on whether countries may or may not want to strictly implement their documentation rules. In the present paper we assume that small countries are less strict in implementing transfer pricing documentation rules than large countries are. Such an assumption captures the empirical regularity that tax havens are small countries.

[17] Allowing for $\gamma_A \neq \gamma_B$ will introduce a different source of ambiguity in the model and again cases can be taken. Having explained the influences that different values of γ_i have in case #2 above, we refrain from repeating here.

(a) When the large host country has the lowest tax, i.e. $t_H > t_A > t_B$, the profit shifting effect will strengthen the home market effect. The MNE will benefit from both the size advantage and the profit shifting advantage that the large country enjoys. The MNE will open its subsidiary in the large country and will move its global profit into that firm.

(b) When the small host country has the lowest tax, i.e. $t_H > t_B > t_A$, the profit shifting effect weakens the home market effect. Each country will then have an advantage and the MNE will have to weight which one is more important for its profit. The result will be ambiguous and it will depend on the parameters of the model.

Despite the general ambiguity that exists in case #3b, we are able to derive a general result that characterizes the shape of the iso-profit curve $\pi^B - \pi^A = 0$, i.e. the curve that determines the locus of points where the MNE will be indifferent on where to locate. Lemma 2 follows:

Lemma 2. *Consider the iso-profit curve defined by $\pi^B - \pi^A = 0$. This curve is always upward sloping in the t_A, t_B space where $t_i < t_H$.*

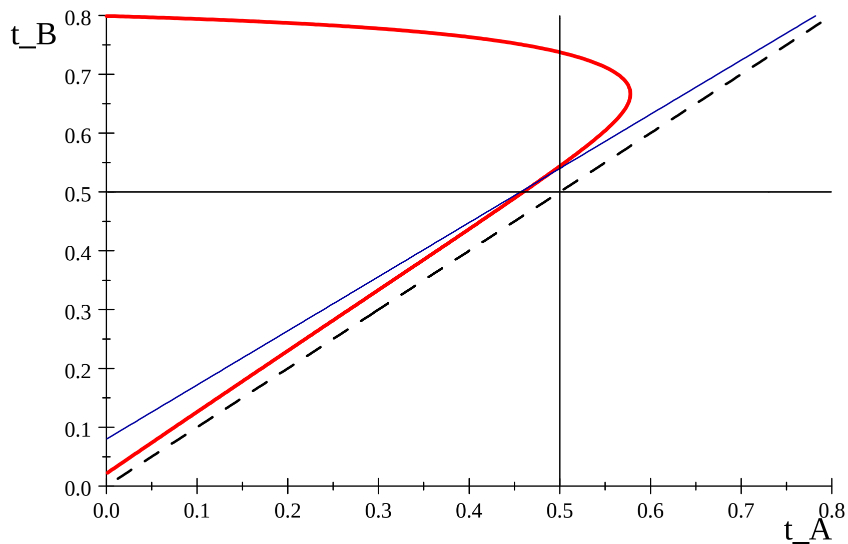
Proof: The proof is delegated to Appendix 2. ■

Thus, as long as the MNE has an incentive to move profits from the parent to the subsidiary, the host countries' taxes will be positively related, i.e. a lower (higher) tax in one country has to be followed by a lower (higher) tax in the other country in order for the MNE to be indifferent on where to locate.

To illustrate how this iso-profit curve behaves, we proceed with a numerical example where we set $N = 3$, $t_H = 0.5$, $\tau = 0.08$, $\gamma_i = 1$ and allow t_A, t_B to vary among the permissible values for the second-order condition for profit maximization to hold. The result is shown below in Figure 1.

The iso-profit curve $\pi^B = \pi^A$ is depicted with the (red) thick curve in Figure 1. For comparison we also depict a (blue) thin line that represents the iso-profit line in the case where profit shifting is not taken into account, i.e. the Haufler and Wooton (1999) case. A (black) dash line shows the 45° line where taxes are equal.

Figure 1

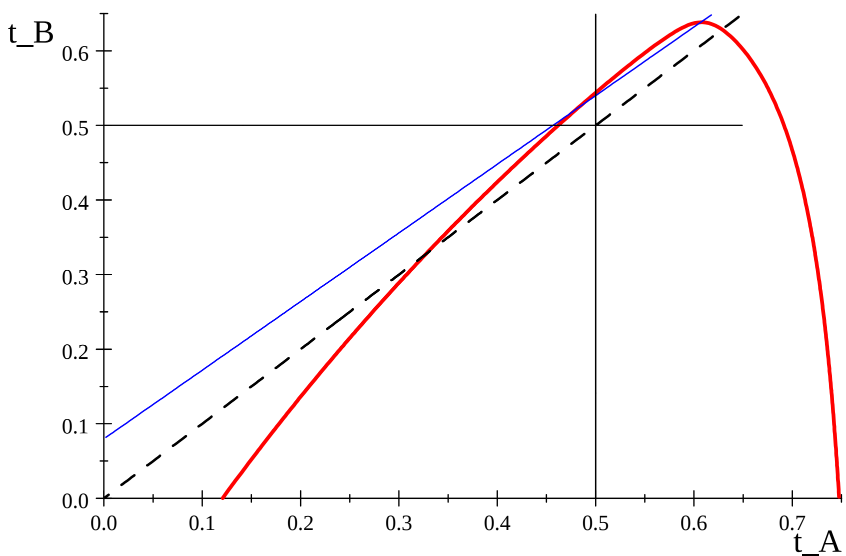


As it is seen, our iso-profit curve is positively slopped in the area where $t_i < t_H = 0.5$ (as Lemma 2 prescribes) but becomes negatively slopped when $t_i > t_H = 0.5$. This represents the case where the MNE moves profits out of the region into the parent firm who faces the lowest tax. This case is somewhat paradoxical and to see this assume that the large country has the highest tax; then increasing that tax will benefit the global MNE as it can do even more profit shifting toward the home country. The MNE will want to locate in the large country due to both profit shifting and home market effects. When that happens, an increase of t_B has to be met by a decrease of t_A for the MNE to remain indifferent between locations.

Focusing on the area where the iso-profit curve is positively slopped, we see that our (red/thick) iso-profit curve intersects with the (blue/thin) HW iso-profit line when taxes are close to 0.5, which is the home tax rate. Indeed, our story should not differ from that of Haufler and Wooton (1999) when taxes are close to the parent's tax rate and where profit shifting is minimal. Notice that this intersection point lies above and to the left of $t_A = t_B = 0.5$ point depicting the large country's home market advantage — the MNE will be indifferent between countries only if $t_B > t_A$. However, as taxes fall below 0.5, the profit shifting effect kicks in and goes against the home market effect. Our iso-profit curve is always below the Haufler-Wooton iso-profit line. In this sense, the area between the HW line and the our curve will be points where ignoring the profit shifting mechanism would have predicted the MNE locating in the large country; however, by taking into account the profit shifting mechanism we see that the MNE will locate in the small country. This area becomes larger the further we move from $t_H = 0.5$ to the right-hand side, i.e. as profit shifting becomes larger. In this sense, the larger the tax difference and thus the profit shifting effect, the smaller the importance of the home market advantage.

Note, however, that in Figure 1 our iso-profit curve never crosses the 45° line, and thus there is a bigger chance for the MNE to locate in the large country. This changes dramatically if we allow for an asymmetry in the leniency that tax authorities show toward transfer pricing documentation rules. For example, if we assume that compared with the large country the small country is more lenient toward tax regulations, i.e. say $\gamma_A = 0.55$ and $\gamma_B = 1$, and we allow t_A, t_B to vary among the (new) permissible values for the second-order condition for profit maximization to hold, then Figure 2 below applies:

Figure 2



Our (red/thick) iso-profit curve crosses the 45° line in two points that both are distant from the no-profit shifting point (where host taxes are close to the home tax). At these two points the MNE experiences the benefit from profit shifting when locating in the small country that is larger than the home market benefit from locating in the large country.[18] Clearly, this illustrates what we talked above under case #2. If in the small country the MNE incurs lower transfer

[18] As previously discussed, the curve becomes negatively slopped when the MNE shifts profits from the high-tax small host country to the low-tax home country. Again this is a paradoxical situation where the small country can keep increasing its tax rate while the MNE still benefits from that.

pricing costs, it can be induced to locate within the small country's borders. This situation captures very well the case of the 'BIG 7' tax havens, i.e. small, non-island, countries that are able to attract production MNE facilities by offering a lenient tax package; see Desai et al. (1996).

4. The Tax Game

Having analyzed how the MNE behaves for given taxes, we now move a step back and see how taxes are set.

At the beginning of the game, countries A and B simultaneously and non-cooperatively announce their tax rates t_A, and t_B respectively. Denote $\underline{t_i}$ the greatest lower bound of the tax rates for which the second-order condition for profits maximization is satisfied when the MNE invests in country i. Denote $\overline{t_i}$ the least upper bound of those tax rates. Note that $\underline{t_i}$ may be negative, i.e. the second-order condition for profits maximization may hold with a range of subsidy rates, and that $\overline{t_i}$ may be greater than t_H. As mentioned previously, we focus on the case where the home tax is the highest among all countries and taxes are non-negative. Country i's strategy set, S_i, is given by:

$$S_i = \begin{cases} [0, t_H] & if \quad \underline{t_i} < 0,\ \overline{t_i} > t_H \\ [0, \overline{t_i}) & if \quad \underline{t_i} < 0,\ 0 < \overline{t_i} < t_H \\ (\underline{t_i}, t_H] & if \quad t_H > \underline{t_i} > 0,\ \overline{t_i} > t_H \\ (\underline{t_i}, \overline{t_i}) & if \quad \underline{t_i} > 0,\ \overline{t_i} < t_H \end{cases}, \ i \in \{A, B\}.$$

Note that the greatest lower bound and the least upper bound of country i's strategy set are given by $\max\left\{\underline{t_i}, 0\right\}$, and $\min\left\{\overline{t_i}, t_H\right\}$ respectively.

To illustrate this 'winner-gets-it-all' competition, assume first that the only objective that a country has is to attract the MNE into its country. The analysis in the previous section can then be applied directly. Since location is the only thing that countries care about, they choose taxes to tip the iso-profit condition to their advantage. The iso-profit curve becomes then a race-to-the-bottom curve, along which countries undercut tax rates to attract the MNE. As it is illustrated in (the lower part of) Figure 1, the race to the bottom stops at its intersection with the vertical axis where the large country wins the MNE even if it charges a positive tax. Moreover, as it is illustrated in Figure 2, a tax lenient small country can easily attract the MNE and charge a positive tax.

Assume next the case where countries set taxes to maximize tax revenues $T_i(t_i)$, $i \in \{A, B\}$.[19] We characterize the Nash tax equilibrium in the following steps. Firstly, we characterize country i's best response.

Lemma 3. *(Best Response) Given country j's tax rate, t_j, country i's best response is:*

$$t_i^{br} = \begin{cases} t_i \in S_i & if \quad \lim\limits_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i) < \pi^j(t_j) \\ \arg \max\limits_{t_i \in \left(\underline{t_i}, z_i\right] \cap [0, z_i]} T_i(t_i) & if \quad \lim\limits_{t_i \to \min\left\{\overline{t_i}, t_H\right\}} \pi^i(t_i) < \pi^j(t_j) < \lim\limits_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i) \\ \arg \max\limits_{t_i \in S_i} T_i(t_i) & if \quad \pi^j(t_j) < \lim\limits_{t_i \to \min\left\{\overline{t_i}, t_H\right\}} \pi^i(t_i) \end{cases},$$

where $i \in \{A, B\}$, $j \in \{A, B\}$, and $i \neq j$, and z_i is the tax rate that makes the MNE indifferent between locations, i.e. z_i is determined by:

$$\pi^i(t_i)\big|_{t_i = z_i} = \pi^j(t_j).$$

Proof: Firstly, note that according to Lemma 2 the MNE's after-tax profits decrease with a host country's tax rate, i.e. $\frac{\partial \pi^i(t_i)}{\partial t_i} < 0$, $i \in \{A, B\}$. Given t_j consider the case where:

$$\lim_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i) < \pi^j(t_j),$$

i.e. the MNE makes higher profits in country j than in country i even if it faces the lowest possible tax rate that country i is able to set. As a result, country i cannot win the MNE, and it can choose arbitrarily its tax rates.

Next, consider the case where:

$$\lim_{t_i \to \min\left\{\overline{t_i}, t_H\right\}} \pi^i(t_i) < \pi^j(t_j) < \lim_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i),$$

i.e. country i will lose the MNE if it charges a tax rate as high as possible, while it will win the MNE if it offers a tax rate as low as possible. In other words, there is a chance for country i to win FDI. It is easy to say that a z_i between $\max\left\{\underline{t_i}, 0\right\}$, and $\min\left\{\overline{t_i}, t_H\right\}$, is well defined, and it makes the MNE receive same profits across the two countries when their tax rates are z_i, and t_j

[19] The case where countries maximize national welfare is analyzed in Appendix 3. The results there are less clear as inclusion of consumer surplus opens up the possibility that a country is better off *not* winning the MNE location game.

respectively. Again, since $\frac{\partial \pi^i(t_i)}{\partial t_i} < 0$, any t_i in country i's strategy set which is below or equal to z_i, $t_i \in \left(\underline{t_i}, z_i\right] \cap [0, z_i]$,[20] can help country i win the MNE. Clearly country i will choose an optimal tax rate, i.e. a tax rate maximizing its tax revenue over $\left(\underline{t_i}, z_i\right] \cap [0, z_i]$.

Finally, consider the case where:

$$\pi^j(t_j) < \lim_{t_i \to \min\left\{\overline{t_i}, t_H\right\}} \pi^i(t_i),$$

i.e. even if facing country i's highest possible tax rate, the MNE finds that it is still profitable to locate in that country. Since $\frac{\partial \pi^i(t_i)}{\partial t_i} < 0$, any t_i in country i's strategy set can help country i win the MNE. Clearly country i will choose a tax rate from its strategy set to maximize its tax revenue. ■

We can illustrate country A's optimal choices in Figure 3 (a similar figure could be drawn for country B's optimal choices).

Figure 3: (around here)

The horizontal axis measures country A's tax rates. The greatest lower bound and the least upper bound of country A's strategy set are given by $\max\left\{\underline{t_A}, 0\right\}$, and $\min\left\{\overline{t_A}, t_H\right\}$ respectively. The vertical axis measures country B's tax rates. The greatest lower bound and the least upper bound of country B's strategy set are given by $\max\left\{\underline{t_B}, 0\right\}$, and $\min\left\{\overline{t_B}, t_H\right\}$ respectively. The upward sloping curve is the iso-profit curve where $\pi^A - \pi^B = 0$. According to Lemma 2, at any point above (below) the iso-profit curve the MNE chooses to locate in country A (country B). A sufficiently low t_B^1 will definitely help country B win the MNE, so any element of country A's strategy set is a best response to t_B^1. When country B's tax rate is at the middle level, say t_B^2, any country A's tax rates which are below or equal to z_A may help country A attract the MNE. In this case, country A will choose the tax rate that maximizes its tax revenue, $t_A^{br}\left(t_B^2\right)$. Finally, when country B's tax rate is high enough, say t_B^3, the MNE will always choose to invest in country A. Country A will again choose a tax rate to maximize its tax revenue, $t_A^{br}\left(t_B^3\right)$.

We can now characterize the Nash tax equilibrium.

Proposition 4. *A combination of tax rates where country i chooses t_i that is as close to*

[20] Note $\left(\underline{t_i}, z_i\right] \cap [0, z_i] = [0, z_i]$, if $\underline{t_i} < 0$; while $\left(\underline{t_i}, z_i\right] \cap [0, z_i] = \left(\underline{t_i}, z_i\right]$ if $\underline{t_i} > 0$.

$\max\left\{\underline{t_i}, 0\right\}$ *as possible, while* $t_j = \arg \max_{t_j \in \left(\underline{t_j}, z_j^0\right] \cap \left[0, z_j^0\right]} T_j$*, constitutes a Nash equilibrium in which country* j *wins tax competition for the MNE, when:*

$$\lim_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i) < \lim_{t_j \to \max\left\{\underline{t_j}, 0\right\}} \pi^j(t_j),$$

$i \in \{A, B\}$, $j \in \{A, B\}$, *and* $i \neq j$, *where* z_j^0 *is defined as* $\lim_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i) = \pi^j(t_j)\big|_{t_j = z_j^0}$.

Proof: Lemma 2 implies that the Nash tax game is in nature a Bertrand competition: countries A and B always have an incentive to undercut its rival's tax rate. As a result, when in the bottom: $t_i \to \max\left\{\underline{t_i}, 0\right\}$, $t_j \to \max\left\{\underline{t_j}, 0\right\}$, the MNE chooses to locate in country j, country i can never win tax competition. According to Lemma 3, it is straightforward to see that $t_j = \arg \max_{t_j \in \left(\underline{t_j}, z_j^0\right] \cap \left[0, z_j^0\right]} T_j$ is a best response to $t_i \to \max\left\{\underline{t_i}, 0\right\}$, and *vice versa.* ■

While the above proposition characterizes a Nash equilibrium it does not determine which one of competing countries will win FDI. As previously, we turn to numerical simulations and use the same two examples as before. The new thing now is that we derive the Nash taxes in the case of tax revenue maximization.

(i) Using the parameters $N = 3$; $\tau = 0.08$; $t_H = 0.5$; $\gamma_A = \gamma_B = 1$, we can show that $\underline{t_i} = -0.309$, and $\overline{t_i} = 0.809$. Thus, the strategy space for each country is $t_i \in [0, 0.5]$, $i \in \{A, B\}$. It is then straightforward to show that the iso-profit curve intersects with the vertical axis as $\pi^A(t_A)\big|_{t_A=0} < \pi^B(t_B)\big|_{t_B=0}$ at $z_B^0 = 0.021$. We can also calculate that country B's tax revenues increase with its tax rates on $[0, 0.021]$. Thus, the Nash tax equilibrium is given by: $t_A = 0$, $t_B = 0.021$.

(ii) If instead we used the parameters $N = 3$, $\tau = 0.08$, $t_H = 0.5$, $\gamma_A = 0.55$, $\gamma_B = 1$, then we can show that $\underline{t_A} = -0.032$, $\overline{t_A} = 0.757$; $\underline{t_B} = -0.309$, $\overline{t_B} = 0.809$. Thus the strategy space for each country is $t_A \in [0, 0.5]$, and $t_B \in [0, 0.5]$. It is then easy to calculate that the horizontal intercept of the iso-profit curve is $z_A^0 = 0.12$, i.e. $\pi^A(t_A)\big|_{t_A=0} > \pi^B(t_B)\big|_{t_B=0}$. Since country A's tax revenues are maximized when $t_A = 0.032$, the Nash equilibrium is given by: $t_B = 0$, $t_A = 0.032$.

Concluding Remarks

This paper emphasizes a mechanism that cannot be ignored when countries compete for a MNE plant, viz. profit shifting. Attracting a MNE implies that there is a parent company out there that will be willing to practice profit shifting with its new subsidiary as long as there is a difference between home and host tax rates. Profit shifting may be more profitable than other location advantages as, e.g. market size. Thus, locating in a small country with lax tax regulations can be much more profitable than locating in a large country that has a market size advantage.

By allowing a profit shifting mechanism we demonstrate that, in general, it can either counteract or support the market size advantage that a large country has. If the profit shifting effect supports the market size advantage, the large country will capitalize on its enhanced advantage and sustain a too high tax. A more realistic case is when the profit shifting effect counteracts the market size advantage. In that case the large country sees its market size advantage, and thus its ability to tax the MNE, to wither. The small country instead will see an opportunity to attract the MNE within its borders by offering an attractive tax package; a package that may include lenient implementation of transfer pricing regulations. With transfer prices being the instrument that MNEs use to shift profits, such a leniency can be very profitable for them.

In our analysis we treated the home tax, i.e. the tax that the parent company faces, **as** fixed. Of course this was a simplification and in reality profit shifting should also have an effect on the tax that the home country chooses. Moreover, we treated the leniency of tax regulations as something exogenous. We simply introduced an asymmetry between the small country and the large country arguing that small countries are usually more interested in being tax lenient than large countries. It may be prudent to analyze a situation where both tax rates and leniency of tax regulations are set non-cooperatively and examine whether the small country will be more lenient than the large country in equilibrium. Such a model will need to provide a rationale for taxes, e.g. existence of public goods or political economy considerations, and study how this rationale is affected by country size. All that is left for future research.

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Appendix 1

In this appendix we determine the second-order condition for profit maximization.

When the multinational firm invests in country A, it is straightforward to calculate:

$$\frac{\partial^2 \pi^A}{\partial q_A^2} = -\gamma_A, \qquad \frac{\partial^2 \pi^A}{\partial Q_A^{A2}} = -2\left(1-t_A\right), \qquad \frac{\partial^2 \pi^A}{\partial Q_B^{A2}} = -\frac{2}{N}\left(1-t_A\right);$$
$$\frac{\partial^2 \pi^A}{\partial q_A \partial Q_A^A} = \frac{\partial^2 \pi^A}{\partial Q_A^A \partial q_A} = t_A - t_H, \qquad \frac{\partial^2 \pi^A}{\partial q_A \partial Q_B^A} = \frac{\partial^2 \pi^A}{\partial Q_B^A \partial q_A} = t_A - t_H,$$
$$\frac{\partial^2 \pi^A}{\partial Q_A^A \partial Q_B^A} = \frac{\partial^2 \pi^A}{\partial Q_B^A \partial Q_A^A} = 0.$$

So, the Hessian matrix is:

$$H = \begin{bmatrix} -\gamma_A & t_A - t_H & t_A - t_H \\ t_A - t_H & -2\left(1-t_A\right) & 0 \\ t_A - t_H & 0 & -\frac{2}{N}\left(1-t_A\right) \end{bmatrix}.$$

When this matrix is strictly negatively definite, the profit function will be strictly concave. Since we have:

$$|H_1| = -\gamma_A,$$
$$|H_2| = \begin{vmatrix} -1 & t_A - t_H \\ t_A - t_H & -2\left(1-t_A\right) \end{vmatrix} = 2\gamma_A\left(1-t_A\right) - \left(t_A - t_H\right)^2,$$
$$|H_3| = |H| = \begin{vmatrix} -1 & t_A - t_H & t_A - t_H \\ t_A - t_H & -2\left(1-t_A\right) & 0 \\ t_A - t_H & 0 & -\frac{2}{N}\left(1-t_A\right) \end{vmatrix}$$
$$= -\frac{4}{N}\gamma_A\left(1-t_A\right)^2 + \left(2+\frac{2}{N}\right)\left(1-t_A\right)\left(t_A - t_H\right)^2,$$

we require that:

$$|H_2| > 0 \Rightarrow 2\gamma_A\left(1-t_A\right) - \left(t_A - t_H\right)^2,$$

and

$$|H_3| < 0 \Rightarrow -\frac{4}{N}\gamma_A\left(1-t_A\right)^2 + \left(2+\frac{2}{N}\right)\left(1-t_A\right)\left(t_A - t_H\right)^2 < 0$$
$$\Rightarrow 2\gamma_A\left(1-t_A\right) - \left(N+1\right)\left(t_A - t_H\right)^2 > 0. \qquad \text{(A1.1)}$$

Thus, when condition (A1.1) is satisfied, the profit function is a strictly concave one.

A similar procedure for when the multinational firm invests in country B gives the following second-order condition:

$$2\gamma_B\left(1-t_B\right) - \left(N+1\right)\left(t_B - t_H\right)^2 > 0. \qquad \text{(A1.2)}$$

Appendix 2

In this appendix we provide the proof of Lemma 2.

Define:

$$\pi^A(t_A) \equiv \max_{\{Q_A^A, Q_B^A, q_A\}} (1-t_A)\left[(1-Q_A^A-q_A)Q_A^A + \left(1-\frac{1}{N}Q_B^A-\tau-q_A\right)Q_B^A\right] + (1-t_H)\left[q_A\left(Q_A^A+Q_B^A\right)\right] - \frac{1}{2}\gamma_A q_A^2.$$

Applying the Envelope theorem, we can show that:

$$\frac{\partial \pi^A(t_A)}{\partial t_A} = -\left[(1-Q_A^A-q_A)Q_A^A + \left(1-\frac{1}{N}Q_B^A-\tau-q_A\right)Q_B^A\right] < 0.$$

The square bracket term is definitely positive when $q_A < 0$. In turn, the latter is true when $t_A < t_H$.

Similarly, we define:

$$\pi^B(t_B) \equiv \max_{\{Q_A^B, Q_B^B, q_B\}} (1-t_B)\left[(1-Q_A^B-\tau-q_B)Q_A^B + \left(1-\frac{1}{N}Q_B^B-q_B\right)Q_B^B\right] + (1-t_H)\left[q_B\left(Q_A^B+Q_B^B\right)\right] - \frac{1}{2}\gamma_B q_B^2.$$

and thus, for the same reason as above, we can derive:

$$\frac{\partial \pi^B(t_B)}{\partial t_B} = -\left[(1-Q_A^B-\tau-q_B)Q_A^B + \left(1-\frac{1}{N}Q_B^B-q_B\right)Q_B^B\right] < 0.$$

By totally differentiating the iso-profit equation $\pi^B(t_B) - \pi^A(t_A) = 0$, we can calculate its slope in the $t_H > t_A, t_B$ space as:

$$\frac{dt_B}{dt_A} = \frac{\partial \pi^A(t_A)/\partial t_A}{\partial \pi^B(t_B)/\partial t_B} > 0.$$

Appendix 3

In this appendix, we consider the case where countries' objective is to maximize national welfare.

Country i's national welfare W_i consists of its consumption surplus $CS_i(t_i)$ plus its tax revenues $T_i(t_i)$ it collects when the MNE chooses to locate within its border. When the MNE chooses to locate in the other country, j, country i only receives its consumption surplus.[21] Formally, country i's objective function is as follows:

$$W_i = \begin{cases} CS_i(t_i) + T_i(t_i) & if \quad \text{FDI in } i \\ CS_i(t_j) & if \quad \text{FDI in } j \end{cases},$$

$i, j \in \{A, B\}$, $i \neq j$.

In the first place, we derive a country's best response in Nash tax competition.

[21] The MNE's profits are repatriated back to the home country and therefore are not part of the host country's national welfare.

Lemma A1: *(Best Response) Given country j's tax rate, t_j, country i's best response is:*

$$t_i^{br} = \begin{cases} t_i \in S_i & if \quad \lim\limits_{t_i \to \max\{\underline{t_i}, 0\}} \pi^i(t_i) < \pi^j(t_j) \\ \arg\max\limits_{t_i \in S_i} W_i \\ s.t.\ CS_i(t_i) + T_i(t_i) \geq CS_i(t_j) & if \quad \lim\limits_{t_i \to \min\{\overline{t_i}, t_H\}} \pi^i(t_i) < \pi^j(t_j) < \lim\limits_{t_i \to \max\{\underline{t_i}, 0\}} \pi^i(t_i) \\ \arg\max\limits_{t_i \in S_i} CS_i(t_i) + T_i(t_i) & if \quad \pi^j(t_j) < \lim\limits_{t_i \to \min\{\overline{t_i}, t_H\}} \pi^i(t_i) \end{cases},$$

where z_i^c is determined by:

$$\pi^i(t_i)\big|_{t_i = z_i^c} = \pi^j(t_j); \qquad i, j \in \{A, B\}, i \neq j.$$

Proof: First, consider the case where $\lim\limits_{t_i \to \max\{\underline{t_i}, 0\}} \pi^i(t_i) < \pi^j(t_j)$, i.e. the MNE makes higher profits in country j than in country i even if it faces the lowest possible tax rate that country i is able to set. Since country i cannot win the MNE, it can choose arbitrarily its tax rate since its consumption surplus $CS_i(t_j)$ is independent of its own tax rates.[22]

Next, consider the case where $\lim\limits_{t_i \to \min\{\overline{t_i}, t_H\}} \pi^i(t_i) < \pi^j(t_j) < \lim\limits_{t_i \to \max\{\underline{t_i}, 0\}} \pi^i(t_i)$, i.e. country i will lose the MNE if it charges its highest possible tax rate, while it will win the MNE if it offers its lowest possible tax rate. By definition, a z_i^c between $\underline{t_i}$ and $\overline{t_i}$ makes the MNE receive same profits across the two countries. Since $\frac{\partial \pi^i(t_i)}{\partial t_i} < 0$, any t_i in country i's strategy set which is below or equal to z_i^c, i.e. $t_i \in (\underline{t_i}, z_i^c] \cap [0, z_i^c]$,[23] can help country i win the MNE. Country i will need to do the following comparison: (i) set a tax rate that maximizes $CS_i(t_i) + T_i(t_i)$ over $(\underline{t_i}, z_i^c] \cap [0, z_i^c]$, or (ii) set a tax rate $t_i \in [z_i^c, \overline{t_i}) \cap [z_i^c, t_H]$ that induces the MNE to locate in country j and receive $CS_i(t_j)$.

Finally, consider the case where $\pi^j(t_j) < \lim\limits_{t_i \to \min\{\overline{t_i}, t_H\}} \pi^i(t_i)$, i.e. even if facing country i's highest possible tax rate, the MNE finds it profitable to locate in country i. Then, again since $\frac{\partial \pi^i(t_i)}{\partial t_i} < 0$, any t_i in country i's strategy set can help country i win FDI competition. Clearly country i will choose a tax rate from its strategy set to maximize $CS_i(t_i) + T_i(t_i)$. ■

Note that though Lemma A1 and Lemma 3 look similar, the former is a more complicated one since making the MNE locate in the rival country may be a country's optimal choice.

Before going further, we make two remarks. First, note that a country's consumption surplus decreases with tax rates irrespective of FDI location.[24]

$$\frac{\partial CS_i(t_i)}{\partial t_i} < 0, \ \frac{\partial CS_i(t_j)}{\partial t_j} < 0.$$

This proves to be helpful below when we characterize Nash equilibrium tax rates.

Second, we further explore the implications of the second part of the above lemma. Suppose that for country i there exists a country j's tax rate, say t_j^c, such that country i's national

[22] Basically, there is no corporate income tax base generated in the country and thus its corporate income tax rate can be set to anything.

[23] Note that $(\underline{t_i}, z_i^c] \cap [0, z_i^c] = [0, z_i^c]$, if $\underline{t_i} < 0$; while $(\underline{t_i}, z_i^c] \cap [0, z_i^c] = (\underline{t_i}, z_i^c]$ if $\underline{t_i} > 0$.

[24] It is straightforward to calculate: $CS_i(t_i) = \frac{1}{2} Q_i^{i2}$, while $CS_i(t_j) = \frac{1}{2} Q_i^{j2}$. And it is easy to show: $\frac{\partial Q_i^i}{\partial t_i} < 0$,

welfare under FDI is the same as its consumption surplus under no FDI.[25] In that case we know that when $t_j < t_j^c$, country i does not have an incentive to attract FDI, while when $t_j > t_j^c$, country i prefers competing for FDI to not competing. To see this note that if $t_j < t_j^c$, we can find a z_i^{c-} such that any country i's tax rate which is below or equal to z_i^{c-} can help country i win the MNE. According to Lemma 2, $z_i^{c-} < z_i^{c0}$. Hence, the maximized national welfare over $\left(\underline{t_i}, z_i^{c-}\right] \cap \left[0, z_i^{c-}\right]$ must be smaller than or equal to the maximized national welfare over $\left(\underline{t_i}, z_i^{c0}\right] \cap \left[0, z_i^{c0}\right]$ since the former interval is a proper subset of the latter one. At the same time, since a country's consumption surplus decreases with tax rates, we have $CS_i(t_j) > CS_i\left(t_j^c\right)$. A similar argument can be used when $t_j > t_j^c$.[26]

Characterization of Nash equilibrium tax rates.

Case 1. For an arbitrarily given t_j, such that:

$$\lim_{t_i \to \min\left\{\overline{t_i}, t_H\right\}} \pi^i(t_i) < \pi^j(t_j) < \lim_{t_i \to \max\left\{\underline{t_i}, 0\right\}} \pi^i(t_i),$$

there exists a $t_i \in \left(\underline{t_i}, z_i^c\right] \cap [0, z_i^c]$, which solves a constrained national welfare maximization problem. Hence, like the case of tax revenue maximization, we again have in nature a Bertrand competition. We replace countries' tax revenues with consumption surplus plus tax revenues as their objective functions in Proposition 4, and then we characterize Nash tax rates in this case.[27]

Case 2. The statement in Case 1 is only true for one country, without loss of generality, say country i. For country j, we can find a threshold country i's tax rate, t_i^c, such that country j's national welfare under FDI is equal to that when the MNE locates in country i. Denote given t_i^c country j's tax rate for the MNE to receive same profits across the two countries as z_j^{c0}. Now, country i chooses a $t_i \in \left(\underline{t_i}, t_i^c\right] \cap [0, t_i^c]$ to maximize $CS_i(t_i) + T_i(t_i)$. Country i choosing such a tax rate and country j choosing z_j^{c0} constitute a Nash equilibrium.[28]

$\frac{\partial Q_i^j}{\partial t_j} < 0$. In particular,

$$\begin{aligned}
\frac{\partial Q_A^A}{\partial t_A} &= \frac{\gamma_A(1+N(1-\tau))(t_A-t_H)(2-t_A-t_H)}{\left[2\gamma_A(1-t_A)-(N+1)(t_A-t_H)^2\right]^2} < 0, \\
\frac{\partial Q_A^B}{\partial t_B} &= \frac{\gamma_B(N+1-\tau)(t_B-t_H)(2-t_B-t_H)}{\left[2\gamma_B(1-t_B)-(N+1)(t_B-t_H)^2\right]^2} < 0; \\
\frac{\partial Q_B^B}{\partial t_B} &= \frac{\gamma_B N(N+1-\tau)(t_B-t_H)(2-t_B-t_H)}{\left[2\gamma_B(1-t_B)-(N+1)(t_B-t_H)^2\right]^2} < 0, \\
\frac{\partial Q_B^A}{\partial t_A} &= \frac{\gamma_A N(1+N(1-\tau))(t_A-t_H)(2-t_A-t_H)}{\left[2\gamma_A(1-t_A)-(N+1)(t_A-t_H)^2\right]^2} < 0.
\end{aligned}$$

[25] Note that here we can find a z_i^{c0}, which is determined by $\pi^i(t_i)\big|_{t_i = z_i^{c0}} = \pi^j\left(t_j^c\right)$.

[26] This argument is spelled out here. Given a $t_j > t_j^c$, we can find a z_i^{c+}, such that any country i's tax **rate** which is below or equal to z_i^{c+} can help country i win the MNE. According to Lemma 2, $z_i^{c+} > z_i^{c0}$. Hence, the maximized national welfare over $\left(\underline{t_i}, z_i^{c+}\right] \cap \left[0, z_i^{c+}\right]$ must be greater than or equal to the maximized national welfare over $\left(\underline{t_i}, z_i^{c0}\right] \cap \left[0, z_i^{c0}\right]$ since the latter interval is a proper subset of the former one. At the same time, since a country's consumption surplus decreases with tax rates, **(a comma here)** we have $CS_i(t_j) < CS_i\left(t_j^c\right)$.

[27] Note that compared with the case of tax revenue maximization, the tendency of 'race to the bottom' is reinforced when consumption surplus decreases with tax rates.

[28] Given z_j^{c0}, t_i^c helps country i win FDI who then chooses a tax rate to maximize national welfare. Given

Case 3. The statement in Case 1 is not true for two competing countries. Like discussion in Case 2, we can find a threshold country j's tax rate, t_j^c, such that country i's national welfare under FDI is equal to that when the MNE locates in country j.

Subcase 3.1. Clearly, we cannot have a Nash equilibrium when $t_i > t_i^c$, $i \in \{A, B\}$. In this case, every country has an incentive to undercut its rival country's tax rate.

Subcase 3.2. When $t_i \leq t_i^c$, a Nash equilibrium is characterized as follows. Country i chooses t_i^c, while country j chooses an optimal tax rate to attract FDI. It is obvious to see that country j's national welfare under FDI is the same as that under no FDI, so its tax rate chosen is trivially a best response to t_i^c. Since given that country j chooses such a tax rate, the MNE will locate in country j, country i's national welfare is independent of its own tax rates, t_i^c is trivially a best response to country j's tax rate. $i, j \in \{A, B\}$, $i \neq j$.[29]

Subcase 3.3. $t_i \leq t_i^c$, while $t_j > t_j^c$. In this case, country i has an incentive to attract FDI, while country j does not have such an incentive. We construct an equilibrium in the following way. Firstly, note that in an equilibrium outcome, it must be the case that country i wins FDI. Next, arbitrarily given a $t_j > t_j^c$, country i's national welfare is always maximized at a particular tax rate, $t_i \leq \min\{t_i^c, z_i^c\}$. This t_i and any $t_j > t_j^c$ constitute a Nash equilibrium. It is easy to see that country i does not have an inventive to deviate. For country j, it cannot induce country i to set a lower tax rate by lowering t_j, and in turn, increasing its consumption surplus. $i, j \in \{A, B\}$, $i \neq j$.

Note that compared with the first case, in the latter two cases, the tendency of 'race to the bottom' may be weakened. This is not surprising since in these situations at least one country does not have an incentive to engage in FDI competition in an equilibrium outcome.

country i's tax rate, any tax rate that is equal to or strictly greater than z_j^{c0} is optimal for country j. However, if country j's tax rate is strictly greater than z_j^{c0}, there may exist a profitable deviation for country i.

[29] A Nash equilibrium does not exist when $t_i < t_i^c$, and $t_j < t_j^c$. To see this, without loss of generality, suppose that given such a pair of tax rates, the MNE chooses to locate in country i. However, the highest possible national welfare that country i can achieve is smaller than or equal to $CS_i\left(t_j^c\right)$, which is strictly smaller than $CS_i\left(t_j\right)$ since a country's consumption surplus decreases with tax rates. So, country i has an incentive to choose a sufficiently high tax rate to make the MNE locate in country j.

Figure 3: Government A's best response choices