Production Location of Multinational Firms under Transfer Pricing: The Impact of the Arm's Length Principle*

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Abstract

When multinational enterprises (MNEs) separate the geographical location of affiliates, they can shift profits between the affiliates by manipulating intra-firm prices of inputs. We show that if the international tax difference between the parent and the host countries is large, MNEs choose to separately locate their affiliates in the two countries. We also investigate the impact of the arm's length principle (ALP) on the location choice, which requires that the intra-firm price of inputs should be set equal to that of similar inputs for the independent downstream firms. The ALP may change the location choice of MNEs.

Keywords: Multinational enterprises (MNEs); Transfer pricing; Production location choice; Intra-firm trade; Arm's length principle (ALP)

JEL classifications: F12; F23; H25; H26

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1. Introduction

The manner in which multinational enterprises (MNEs) organize their production structure is essential for their international strategy. As MNEs can substantially benefit from the opportunity to locate their affiliates in several countries, their location decisions depend on country-specific characteristics, such as the extent of competition and policies proposed by the governments. Considerable research has been undertaken to investigate the determinants of MNEs' locations from both theoretical and empirical standpoints.[1] Among other factors affecting the location choice, the corporate taxation prevalent in both the host and parent countries is known to have a significant impact.[2]

When considering a firm with a single plant, the consequences of corporate taxation are straightforward; the firm locates its production in a country with a lower tax rate to save taxes. However, the impact of taxation on MNEs' location choice is not this simple. The striking difference between MNEs with multiple plants or affiliates and single-plant firms is that MNEs' transactions may take place within their organization across borders, which is not the case for single plant firms. This means that MNEs can partly control prices of intermediate goods for foreign affiliates, which are known as *transfer prices*, through intra-firm trade in order to reduce global tax payments. Thus, it is possible that using such a transfer pricing strategy, MNEs locate their production in a high-tax country, while exporting inputs to their affiliates located in a low-tax country.

The relationship between corporate tax rates and the location choice of MNEs under transfer pricing is not just a theoretical curiosity, but is of great importance to the modern economy. Along with the progress of economic integration, intra-firm trade has grown dramatically in recent years, which provides MNEs room for tax manipulations through transfer

[1]For comprehensive surveys, see Markusen (2004); Navaretti and Venables (2004); and Blonigen (2005).

[2]Hebous et al. (2011) show that lower corporate tax induces inflows of foreign capital irrespective of the type of investment, such as greenfield foreign direct investment and cross-border mergers and acquisitions. Voget (2011) finds that one percentage point decline in foreign effective tax rate augments the likelihood of headquarters' relocation by 0.22 percentage point. Karkinsky and Riedel (2012) and Griffith et al. (2014) investigate the link between corporate taxation and patent location.

pricing.[3][4] Recently, the OECD launched a project involving over 80 countries to address the tax avoidance behavior of MNEs, which includes transfer pricing.[5] According to the OECD, revenue losses from tax avoidance by MNEs are estimated to be between 4% and 10% of global corporate income tax revenues.[6] Despite the growing concern globally, limited work seems to be undertaken in terms of the interaction between MNEs' location choice and their transfer pricing strategy. The first objective of this paper is to examine how corporate tax rates affect the production location decision of MNEs using transfer pricing.

From the government's perspective, there is no doubt that steps preventing MNEs from tax manipulations are indispensable for collecting tax revenues. Many countries adopt a transfer pricing tax system to infer whether MNEs avoid tax payments. The key idea to appropriate the transaction price for related affiliates is the arm's length principle (ALP) which is set out in Article Nine of the OECD Model Tax Convention. The principle points out that transfer price should be the same used for an unrelated firm under similar conditions, the so-called "arm's length price." The second objective of this paper is to investigate the impact of the ALP on MNEs' tax avoidance and production location choice.

This paper presents a simple two-country model with a vertically-related MNE, whose headquarters is located in the parent country, and a downstream local rival in the host country. Corporate tax rates are exogenous and the rate in the parent country is assumed to be higher than that in the host country. The headquarters of the MNE chooses the location of an upstream affiliate, while it has a downstream affiliate in the host country and its location is fixed. The link between the location choice of upstream production and tax-avoidance strategy under the cases with and without the ALP are investigated. We show that if the ALP is not imposed (i.e., different input prices for related and unrelated downstream firms are

[3] Bernard et al. (2010) show that over 46 percent of U.S. imports composed of intra-firm transactions in 2000. Lanz and Miroudot (2011) report that U.S. imports of intermediate products score around 50 percent in 2009. See also Slaughter (2000) and Hanson et al. (2005) for the importance of intra-firm trade.

[4] For (in)direct evidence on transfer pricing, see Swenson (2001); Bartelsman and Beetsma (2003); Clausing (2003); Bernard et al. (2006); Davies et al. (2015); and Gumpert et al. (2016).

[5] The project is called "Base Erosion and Profit Shifting:" https:// www.oecd.org/g20/topics/taxation/beps.htm, accessed on 17 March 2017.

[6] See http://www.oecd.org/ctp/oecd-presents-outputs-of-oecd-g20-beps-project-for-discussion-at-g20-finance-ministers-meeting.htm, accessed on 17 March 2017.

permitted), the MNE may locate an upstream affiliate in a high-tax parent country. However, if the ALP is imposed (i.e., equal prices for the two downstream firms are mandatory), the MNE simply chooses a low-tax host country for upstream production. There exist tax rates for which the imposition of the ALP changes the location pattern. We also show that the location change induced by the ALP leads to smaller tax revenues in the host country, but generally greater revenues globally.

At first glance, it seems surprising that the upstream affiliate may be located in the high-tax country. To grasp the intuition behind the result, consider how the MNE chooses input prices. If the MNE separates the location of its affiliates, the optimal transfer price for its affiliates is based on *tax-manipulation* and *strategic* purposes. The tax-manipulation motive drives the MNE to set the transfer price so as to shift profits from a high-tax country to a low-tax country. When the host country, where the downstream affiliate is located, has a lower tax rate than the parent country, the MNE attempts to reduce the transfer price of inputs and increase the profit of the downstream affiliate with a view to saving global tax payments.

The strategic motive suggests that as the upstream affiliate of the MNE has a monopoly power on inputs, the MNE can partly control the downstream market by discriminating input prices for the two downstream firms. Specifically, the MNE has an incentive to choose a low transfer price for the downstream affiliate, and a high arm's length price for the local rival in order to obtain a large share of the downstream market. In short, if the host country has a lower tax rate than the parent country, both tax-manipulation and strategic effects work in the same direction to lower the transfer price. Particularly, if the host's tax rate is much lower than the parent's tax rate, the MNE may locate upstream production in the high-tax parent country to best achieve the transfer pricing strategy. Imposing the ALP requires the MNE to set equal input prices and thus limits the effectiveness of transfer pricing. As such, under the ALP, the MNE simply prefers to locate its upstream affiliate in the low-tax country.

Our contribution is to consider the location choice of MNEs using transfer pricing, to which most of the studies in the literature have provided limited attention. The main interest of the previous studies is to understand how transfer prices are affected by international differences in, e.g., corporate tax rates, tax systems and trade barriers.[7] Schjelderup and Sørgard (1997) and Zhao (2000) made early attempts to introduce the strategic purposes of transfer price and tax manipulation.[8] They find that under Cournot competition, MNEs tend to set a transfer price lower than the marginal cost, even when there are no corporate tax differences. Within a similar framework, Nielsen et al. (2003) examine how different corporate tax systems, separate accounting and formula apportionment, affect the incentive to engage in transfer pricing differently. Kind et al. (2005) ask the same question in a tax competition framework and also look at the impact of reduction in trade barriers. However, the production location choice of MNEs is outside the scope of these papers.

There are a few papers that address the choice of organization structure of MNEs with profit shifting motives. Nielsen et al. (2008) analyze the impact of different decision structures on transfer prices. The decision on production is made by the headquarters of MNEs (centralization) or the local affiliate (decentralization). Unlike our model, their model fixes the location of affiliates. Using the property-rights approach, Bauer and Langenmayr (2013) and Egger and Seidel (2013) investigate the organization decision on whether to integrate local suppliers or import inputs from independent foreign suppliers. Keuschnigg and Devereux (2013) examine the same question in a model with financial frictions. While they focus on sourcing decisions *across* the boundaries of MNEs ("make or buy" inputs), we emphasize production location decisions *within* the boundaries of MNEs.[9] Closer to the interests of our study, Yao (2013) analyzes the impact of the ALP on MNEs' location choice in a spatial competition model à la Hotelling. In his model, MNEs choose *where* to locate *within a host country*, that is, they choose a point on the "linear-city," whereas in our model MNEs choose *whether* to locate *in a host or parent country.*[10]

[7] Earlier contributions include Copithorne (1971); Horst (1971); Samuelson (1982); and Kant (1988).

[8] Based on our knowledge, the first paper that introduced both tax-manipulation and strategic purposes is Elitzur and Mintz (1996), but there are no interactions with competitors in their model.

[9] In a related context, Choi et al. (2017) find a possibility of dual sourcing where an MNE buys inputs from both independent suppliers and related subsidiaries.

[10] The role of the ALP on transfer prices is also studied by Gresik and Osmundsen (2008); Bauer and Langenmayr (2013); Choe and Matsushima (2013); and Keuschnigg and Devereux (2013). However, they do

Although the location choice of internationally-mobile firms is at the core of the literature on tax competition,[11] the role of the transfer pricing and/or the ALP has not been addressed in the literature. Haufler and Wooton (1999) consider tax competition between potential host countries for a single MNE (or its affiliate) without profit shifting motives.[12] Based on their framework, Ma and Raimondos (2015) allow the MNE to use transfer pricing and examine the effect of the market size of potential host countries. They simplify the vertical structure within the MNE, and are thus unable to analyze the impact of the ALP. In contrast, we take corporate taxes as given, and describe the vertical structure more precisely to address the ALP issue.

The rest of the paper is organized as follows. Section 2 describes the setup of the model. The main analysis is presented in Sections 3 and 4 where the equilibrium outcomes in the benchmark (no-ALP) and the ALP cases are derived. Section 5 analyzes the impact of the ALP on tax revenues and Section 6 concludes the paper.

2. Basic Setting

The economy consists of two countries, a host and a parent country, with two vertically-linked industries, an upstream industry (intermediate input) and an downstream industry (final good). Our focus is on the host country, as the consumption and production of final goods take place only in the host country. An MNE, whose headquarters is located in the parent country, has a downstream affiliate in the host country to compete with a local rival firm in the final goods' market. The downstream affiliate and the local rival produce differentiated products using the intermediate input and engage in Cournot competition.

The (headquarters of the) MNE can choose the location, between the parent country with tax rate T and the host country with tax rate t ($\leq T$), where production of intermediate

not consider the location choice of MNEs.

[11] See Keen and Konrad (2013) for a comprehensive survey.

[12] For subsequent development in the literature on bidding for a firm, see, e.g., Bjorvatn and Eckel (2006); Haufler and Wooton (2006); Ferrett and Wooton (2010); and Furusawa et al. (2015).

inputs for both the downstream affiliate and the independent local firm would take place. By contrast, the location of the downstream affiliate is fixed. The upstream affiliate is the only supplier, which can sell inputs through intra-firm transaction to the downstream affiliate at different prices from those charged to the local firm. If the upstream affiliate is established in the host country together with the downstream affiliate, termed as a *co-location scheme*, it produces inputs in the host country, and sells to both the related and unrelated downstream firms. The price for the related affiliate is called an *internal price* and the price for the independent local firm is called an *arm's length price*. On the other hand, if the upstream affiliate is established in the parent country separate from the downstream affiliate, termed as a *separate-location scheme*, it produces in the parent country and exports to the two downstream firms. The internal price under this scheme can also be called a *transfer price* due to the transactions across borders. The two schemes are illustrated in Fig. 1.

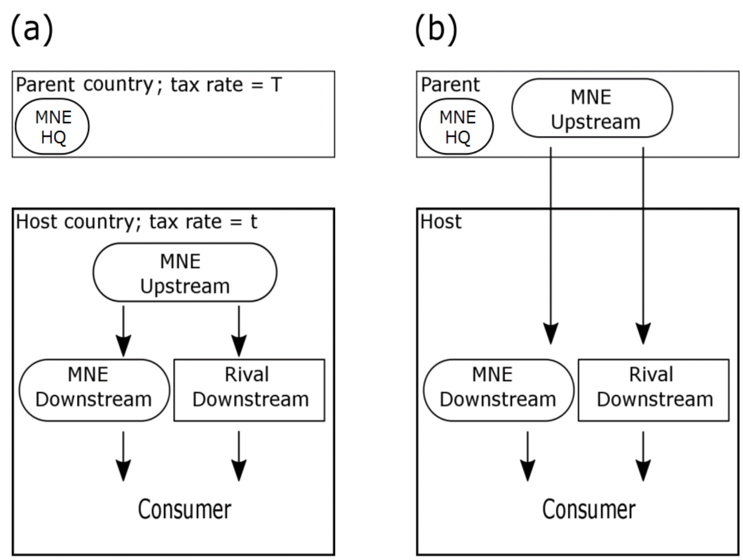

Fig. 1. Model structure: (a) co-location scheme; (b) separate-location scheme

The timing of the game is as follows. First, the MNE locates an upstream affiliate in either the host or the parent country. Second, it sets input prices to maximize the total post-tax profit, which is the sum of the post-tax profits of the upstream and the downstream affiliates. Third, the downstream affiliate and the local firm choose outputs to maximize their own profits.[13] We proceed by analyzing in turn the case where the MNE is free from the arm's length principle (ALP), and the case where it obeys the ALP.

3. Benchmark Case

We first consider the case where the ALP is not imposed: the upstream affiliate can sell to the related downstream affiliate and the independent firm at different prices. The equilibrium outcomes are derived in both the co-location and the separate-location schemes. Comparing the equilibrium profits under the two schemes, we analyze in which country the MNE locates an upstream affiliate, given the tax rates of the host and the parent countries.

3.1. Co-location Scheme

Given the location of upstream production, the MNE first chooses input prices and then the two downstream firms source the inputs to produce final goods. We solve the problem backward.

The two downstream firms choose quantities to maximize their own pre-tax profits. Let π and π_* be the pre-tax profits of the downstream affiliate and the local firm, respectively; the

[13]We consider a decentralized decision structure and the MNE leaves quantity choice to the downstream affiliate. The principal may benefit from delegating its decision to the agent as the delegation works as a commitment device, which is known as the delegation principle (see e.g., Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987). Decentralized decision making is the source of the strategic effect and is widely adopted in the literature on transfer pricing mentioned in the Introduction.

maximization problems are formulated as

$$\max_{q} \ \pi = (p-g)q,$$
$$\max_{q_*} \ \pi_* = (p_*-g_*)q_*,$$
$$\text{where} \ \ p = 1-q-bq_*,$$
$$p_* = 1-q_*-bq.$$

p (p_*) is the final good's price of the downstream affiliate (the local firm) and q (q_*) is the quantity produced by the downstream affiliate (the local firm). The downstream firms use linear production technology, resulting in a one-to-one transformation from intermediate to final goods. g is the price of the intermediate inputs for the downstream affiliate, called the internal price, and g_* is the price for the local firm, called the arm's length price. $b \in (0,1)$ represents the degree of substitutability of the two final goods. Solving the maximization problems gives

$$q = \frac{b(g_*-1)+2(1-g)}{4-b^2}, \tag{1}$$
$$q_* = \frac{b(g-1)+2(1-g_*)}{4-b^2}. \tag{2}$$

Taking into account these demand schedules, the MNE sets input prices for the two downstream firms. Let π_u be the pre-tax profits of the upstream affiliate and Π be the total post-tax profits of the MNE, the MNE faces the following problem:

$$\begin{aligned}\max_{g,g_*} \ \Pi &= (1-T)\bar{\pi} + (1-t)(\pi_u+\pi) \\ &= (1-T)\bar{\pi} + (1-t)[(g-c)q + (g_*-c)q_* + (p-g)q],\end{aligned}$$

where T and t are the corporate tax rate of the parent and host countries, respectively. It is assumed that $t \leq T$ throughout the analysis.[14] $\bar{\pi}$ is constant profits earned (from different

[14]If $t > T$, the upstream affiliate is always located in the low-tax parent country (separate location) in

businesses) in the parent market.[15] $c \in [0, 1)$ is the constant marginal cost of the upstream production.

Deriving the two first-order conditions (FOCs) from the MNE's problem ($d\Pi/dg = 0$; $d\Pi/dg_* = 0$) and solving the system of equations for (g, g_*), the result is

$$g = \frac{1+c}{2} - \frac{(2-b)(1-c)}{2(2-b^2)}, \tag{3}$$

$$g_* = \frac{1+c}{2}, \tag{4}$$

where the second-order conditions (SOCs) trivially hold. As both the upstream and downstream firms co-locate in the host country and face the same tax rate, the equilibrium input prices are independent of tax rates. To earn positive profits from selling inputs, the MNE charges input prices higher than the marginal cost, i.e., $g > c$ and $g_* > c$. The second term in Eq. (3) is negative (noting that $c < 1$ and $b < 1$), implying that the internal price is lower than the arm's length price, i.e., $g < g_*$. This gap can be explained from the fact that the MNE attempts to expand the profits of its downstream affiliate, π. As the internal price falls, the downstream affiliate becomes more competitive against the local firm, and earns more profits. The second negative term in Eq. (3) is called the *strategic effect* of input prices.[16] Due to this strategic motive, the transfer price is likely to be set lower than the arm's length price without tax-manipulation motives, which will be observed in the separate-location scheme.

both the benchmark and ALP cases. Thus, the focus is on the range of $t \le T$, where the imposition of the ALP may change the location pattern. See also footnotes 23 and 28.

[15] This term ensures positive taxable profits in the parent country.

[16] This point can be formally stated as follows. We modify the maximization problem of the MNE as

$$\max_{g, g_*} \ \Pi = (1-T)\bar{\pi} + (1-t)(\pi_u + \beta\pi),$$

where β is a weight attached to the profits of the downstream affiliate. Solving the modified problem gives

$$g = \frac{1+c}{2} - \frac{\beta(2-b)(1-c)}{2(4-b^2-2\beta)}, \qquad g_* = \frac{1+c}{2}.$$

The second term of g, i.e., the strategic effect, vanishes if the MNE puts $\beta = 0$ on π.

Calculating the total post-tax profits Π using the equilibrium choices yields

$$\Pi = (1-T)\bar{\pi} + \frac{(1-t)(3-2b)(1-c)^2}{4(2-b^2)}. \tag{5}$$

3.2. Separate-location Scheme

In the separate-location scheme, where the upstream affiliate is located in the parent country, the two downstream firms behave similarly to the co-location scheme. Suppose S is used to denote variables in the separate-location scheme, using Eqs. (1) and (2), the outputs of final goods can be written as

$$q^S = \frac{b(g_*^S - 1) + 2(1 - g^S)}{4 - b^2},$$
$$q_*^S = \frac{b(g^S - 1) + 2(1 - g_*^S)}{4 - b^2},$$

where g and g_* have been replaced with g^S and g_*^S in Eqs. (1) and (2), respectively.

Given these demand schedules, the MNE chooses input prices to maximize the following total post-tax profit:

$$\begin{aligned}\max_{g^S, g_*^S} \ \Pi^S &= (1-T)(\bar{\pi} + \pi_u^S) + (1-t)\pi^S \\ &= (1-T)[\bar{\pi} + (g^S - c)q^S + (g_*^S - c)q_*^S] + (1-t)(p^S - g^S)q^S.\end{aligned}$$

Our focus is on a certain range of tax rates where the maximization problem has a unique interior solution:

$$\begin{aligned} & t > \underline{t} \equiv \max\{t^a,\ t^b\}, \qquad \text{(A1)} \\ & \text{where} \ \ t^a \equiv (2-b)T - (1-b), \\ & \qquad t^b \equiv \frac{(2-b)(3+bc+b+c)T - (2-b^2)(1+c)}{4 - b(1-c)}. \end{aligned}$$

If t and T satisfy (A1), the equilibrium quantities and final goods' prices are positive, and the SOCs hold in all cases of the following analysis.[17] The regularity condition (A1) is assumed throughout the analysis.[18]

The equilibrium input prices are given by

$$g^S = \underbrace{\frac{1+c}{2} - \frac{(2-b)(1-c)}{2(2-b^2)}}_{=g} - \frac{(2-b)^2(2+b)(1-c)(T-t)}{2(2-b^2)[2t-(4-b^2)T+2-b^2]}, \tag{6}$$

$$g^S_* = \frac{1+c}{2} \; (= g_*). \tag{7}$$

The sum of the first and second terms in Eq. (6) equals the internal price under the co-location scheme (g defined in Eq. (4)). The third term involves the tax difference, which is termed as the *tax-manipulation effect* of input prices. Under the regularity condition, the denominator of the third term is positive and thus its sign depends on the tax difference. If both the countries have the same tax rate ($t = T$), then there is no room for tax manipulation and the equilibrium prices are reduced to the ones in the co-location scheme. If the host country has a lower tax rate than the parent country ($t < T$), then the MNE attempts to shift profits from the high-tax parent to the low-tax host country in order to reduce the transfer price to allow the downstream affiliate to earn more profits in the host country.[19] Both tax-manipulation and strategic effects work in the same manner to lower the transfer price in comparison to

[17] More precisely, $q^S > 0$ requires $t > t^a$, while $p^S > 0$ does $t > t^b$. The SOCs are

$$\frac{d^2\Pi^S}{d(g^S)^2} = -\frac{4[2t-(4-b^2)T+2-b^2]}{(2-b)^2(2+b)^2} < 0, \qquad \frac{d^2\Pi^S}{d(g^S_*)^2} = -\frac{2[b^2t-(4-b^2)T+8-3b^2]}{(2-b)^2(2+b)^2} < 0,$$

$$\frac{d^2\Pi^S}{d(g^S)^2}\cdot\frac{d^2\Pi^S}{d(g^S_*)^2} - \left(\frac{d^2\Pi^S}{dg^S dg^S_*}\right)^2 = \frac{8[2t-(4-b^2)T+2-b^2][b^2t-2(4-b^2)T+8-3b^2]}{(2-b)^4(2+b)^4} > 0.$$

These inequalities hold under (A1).

[18] In all cases of the following analysis, the upstream affiliate (or the headquarters of the MNE) is not allowed to supply inputs only to the downstream affiliate due to, e.g., antitrust laws. If we further assume that the degree of differentiation and the host's tax rate are high enough: $b < 1/2$ and $t > t^f \equiv [2(2-b)T-(1-2b)]/3$, the upstream affiliate always finds it profitable to sell to both the two downstream firms so that the analysis in the text is unchanged.

[19] Clausing (2003) empirically supports this result: she finds that MNEs in the U.S. tend to set lower export prices, as tax rates in the trading partners are lower.

the arm's length price, i.e., $g^S < g^S_*$.[20]

To summarize, for tax-manipulation and strategic motives, the transfer price is likely to be set lower than the arm's length price. As a consequence, the downstream affiliate produces more goods at cheaper prices than their local rival, i.e., $q^S > q^S_*$ and $p^S_* > p^S$.[21] It is noted that the arm's length price g^S_* defined in Eq. (7) is the same as in the co-location scheme, and does not depend on taxes, as the tax manipulation effect is best achieved only through the use of the transfer price g^S.

The total post-tax profits evaluated at the equilibrium choices are given by

$$\Pi^S = (1-T)\left[\bar{\pi} + \frac{(1-c)^2\{t - 2(2-b)T + 3 - 2b\}}{4\{2t - (4-b^2)T + 2 - b^2\}}\right], \tag{8}$$

where the second term in the square bracket is positive under (A1).

3.3. Location Choice

Comparing the total post-tax profits under the two schemes, the MNE chooses a location for upstream production. From Eqs. (5) and (8), the profit difference can be calculated as

$$\Pi - \Pi^S = \frac{\Theta(1-c)^2(T-t)}{2(2-b^2)[2t - (4-b^2)T + 2 - b^2]},$$
$$\text{where} \quad \Theta \equiv (3-2b)t - (4 - 2b - 2b^2 + b^3)T + 1 - 2b^2 + b^3,$$

[20] If $t > T$, the MNE seeks more profits in the low-tax parent country rather than in the high-tax host country in order to set the transfer price high to favor the upstream affiliate. In this case, tax-manipulation and strategic effects work in the opposite direction. However, it can be verified that the strategic effect outweighs and makes the transfer price lower, i.e., $g^S < g^S_*$.

[21] To check these formally, evaluating the downstream quantities and prices at equilibrium input prices gives

$$q^S - q^S_* = \frac{(1-c)(1-t)}{2[2t - (4-b^2)T + 2 - b^2]} > 0,$$
$$p^S_* - p^S = (q^S - q^S_*)(1-b) > 0.$$

In fact, the regularity condition (A1) ensures positive quantities and prices; $q^S_* > 0$ holds if $t > t^a$ and $p^S > 0$ holds if $t > t^b$.

where the denominator is positive. Noting that Θ can take negative values and is increasing in t, the profit difference can be positive or negative.

It is can be easily observed that $\Pi - \Pi^S = 0$ holds at $t = t^*$ or $t = T$, where t^* is defined by

$$t^* \equiv \frac{(4 - 2b - 2b^2 + b^3)T - 1 + 2b^2 - b^3}{3 - 2b} \ (< T). \tag{9}$$

t^* is not necessarily positive; it is likely to be positive if the tax rate of the parent country is sufficiently high:

$$\begin{aligned} & t^* > 0, \\ \to \ & T > \overline{T} \equiv \frac{1 - 2b^2 + b^3}{4 - 2b - 2b^2 + b^3}. \end{aligned} \tag{A2}$$

If t^* is negative, the profit difference is always positive for $t \leq T$.

The profits under the two schemes are drawn in Fig. 2.[22] If (A2) does not hold (Fig. 2.(b)), then $\Pi - \Pi^S \geq 0$ holds for $t \leq T$. The MNE always chooses co-location, where it simply establishes an upstream affiliate in the low-tax host country, together with the downstream affiliate.

If (A2) holds (Fig. 2.(a)), the location choice is more complex. $\Pi - \Pi^S > 0$ holds if t is close to T ($t \in (t^*, T)$). If the tax rates of the two countries are fairly different ($t \in (\underline{t}, t^*)$), then $\Pi - \Pi^S < 0$ holds. The equality $\Pi = \Pi^S$ holds at $t = t^*$ or $t = T$. The MNE chooses to produce intermediate inputs in the host country (co-location), if the two countries have similar tax rates. Otherwise, it prefers the parent country for upstream production (separate location).[23]

[22]These figures are derived using the following parameter values: $b = 0.2$; $c = 0.3$; $\bar{\pi} = 3$; (a)$T = 0.35$; (b)$T = 0.2$. In this numerical example, $\underline{t} = 0$ holds.

[23]If $t > T$, it can be checked that $\Theta > 0$, and thus $\Pi - \Pi^S < 0$ hold. The upstream affiliate is located in the parent country simply for its low tax rate (separate location).

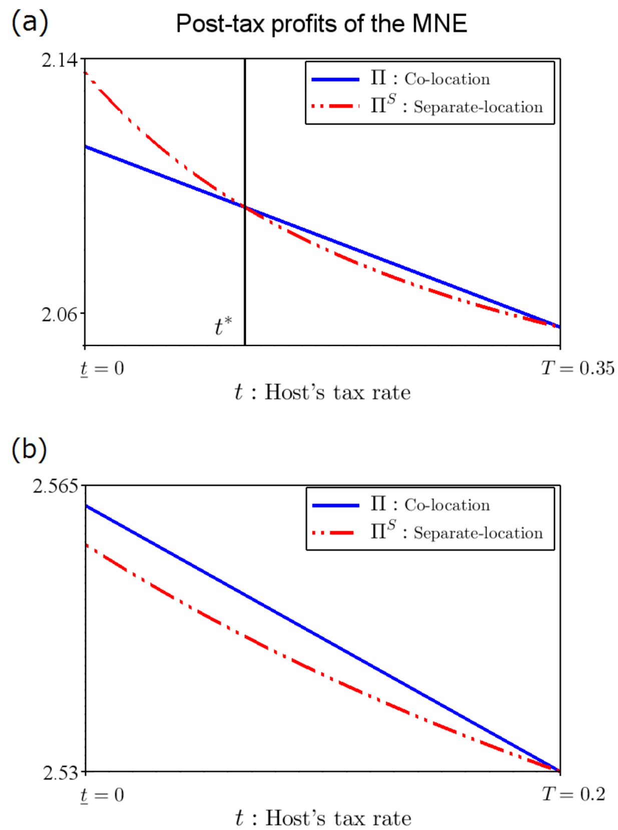

Fig. 2. Production location choice in the benchmark case: (a) high T and (b) low T

If the two countries have equal tax rates, the tax manipulation effect disappears so that the location choice does not matter, i.e., $\Pi = \Pi^S$ at $t = T$. Consider then a marginal decrease in the tax rate of the host country. This reduction in the host tax rate naturally raises the MNE's profits; the marginal impacts on the profits in the co-location and the separate-location schemes are respectively given by

$$
\begin{aligned}
-\left.\frac{d\Pi}{dt}\right|_{t=T} &= -\left.\frac{\partial\Pi}{\partial t}\right|_{t=T} \\
&= \pi_u + \pi\big|_{t=T} \\
&= (g-c)q + (g_* - c)q_* + (p-g)q\big|_{t=T} \\
&= \frac{(1-c)^2(3-2b)}{4(2-b^2)} > 0,
\end{aligned}
$$

$$
\begin{aligned}
-\left.\frac{d\Pi^S}{dt}\right|_{t=T} &= -\frac{\partial\Pi^S}{\partial t} - \left.\frac{\partial\Pi^S}{\partial g^S}\frac{dg^S}{dt}\right|_{t=T} \\
&= \pi^S\big|_{t=T} \\
&= (p^S - g^S)q^S\big|_{t=T} \\
&= \frac{(1-c)^2(2-b)^2}{4(2-b^2)^2} > 0,
\end{aligned}
$$

where we have used $\partial\Pi^S/\partial g^S = 0$ from the MNE's FOCs. Noting that the prices and quantities are equal under both the schemes at equal tax rates, where it holds that $p = p^S$; $g = g^S$; $q = q^S$ at $t = T$, the marginal impact on the profits is higher under the co-location scheme than under the separate-location scheme:

$$
\begin{aligned}
-\left.\frac{d\Pi}{dt}\right|_{t=T} - \left(-\left.\frac{d\Pi^S}{dt}\right|_{t=T}\right) &= (g-c)q + (g_* - c)q_*\big|_{t=T} \\
&= \frac{(1-c)^2(1-b)(1+b-b^2)}{2(2-b^2)^2} > 0.
\end{aligned}
$$

This indicates that if the host country has a slightly lower tax rate than the parent country, upstream production in the host is more profitable than in the parent. Having an affiliate in the parent country is beneficial to the MNE to manipulate tax payments, but it is at the same time disadvantageous due to the higher tax rate of the parent. Under small tax differences between the two countries, there is little room for manipulating tax payments; thus, upstream production in the high-tax parent country becomes less profitable than that in the low-tax host country.

If the two countries have different tax rates, the MNE may prefer upstream production in the parent country in order to exploit the tax difference through transfer pricing. As we have seen, under small tax differences, it is preferable to locate upstream production in the low-tax host country. However, under fairly large tax differences, host production does not necessarily lead to higher total profits. To focus on this point, let us assume (A2) and look at the marginal impacts of taxes on the total profits at $t = t^* > 0$, where $\Pi = \Pi^S$ holds. As in the equal-taxes situation, it can be confirmed that

$$\begin{aligned} -\frac{d\Pi}{dt}\bigg|_{t=t^*} - \left(-\frac{d\Pi^S}{dt}\bigg|_{t=t^*}\right) & \\ &= (\pi_u + \pi) - \pi^S\big|_{t=t^*} \\ &= [(g-c)q + (g_* - c)q_* + (p-g)q] - (p^S - g^S)q^S\big|_{t=t^*} \\ &= -\frac{(1-b)(3-2b)(1+b-b^2)(1-c)^2}{2(2-b)^2(2-b^2)} < 0. \end{aligned}$$

In contrast to the equal-taxes situation, a reduction in t increases total profits in the separate-location scheme more than in the co-location scheme. For $t < T$, the transfer price g^S is set lower to avoid tax payments in the parent country. This lowered price strengthens the strategic effect, and thus makes the downstream affiliate more competitive and earn higher profits π^S.[24] If T is so high that (A2) holds, fairly large tax differences makes the separate-location scheme more profitable.

The results are summarized below.

Proposition 1 (Benchmark case). *Suppose the MNE can set different input prices for its downstream affiliate and the local firm and assume $t \leq T$ and the regularity condition (A1): $t > \underline{t}$. Two cases may arise:*

(i) Suppose the parent country's tax rate is sufficiently high ($T > \overline{T}$). If the host country's tax rate is not sufficiently low ($t \in (t^*, T]$), the MNE locates an upstream affiliate in the low-tax host country ("co-location"). On the other hand, if it is sufficiently low

[24] It holds that $dg^S/dT < 0$ and $d\pi^S/dg^S < 0$, which gives $d\pi^S/dT > 0$.

($t \in (\underline{t}, t^*]$), the upstream affiliate is located in the high-tax parent country ("separate location").

(ii) Suppose the parent country's tax rate is not sufficiently high ($T \leq \overline{T}$). For any host's tax rate ($t \in (\underline{t}, T]$), the MNE always locates an upstream affiliate in the low-tax host country ("co-location").

4. Arm's Length Principle (ALP) Case

We move on to the case where the MNE follows the ALP. It now sets equal prices for both the downstream affiliate and independent local firm.[25]

4.1. Co-location Scheme

As in the previous section, we first solve the third stage game, where the downstream firms choose quantities, and then solve the second stage game, where the MNE chooses input prices. Maximization problems facing the downstream firms are exactly the same as in the benchmark (no-ALP) case, except that both the affiliate and the local firm source inputs at the same price, $\tilde{g}$, where the tilde ($\tilde{}$) represents the variables in the ALP case. Replacing g and g_* with $\tilde{g}$ in Eqs. (1) and (2) gives

$$\tilde{q} = \tilde{q}_* = \frac{1 - \tilde{g}}{2 + b}.$$

[25] We assume that the ALP applies to both cross-border transactions (i.e., separate location) and domestic transactions (i.e., co-location). Article Nine and the OECD guidelines are fully or partly applicable to domestic transfer pricing in some member countries of the OECD such as the U.K., Norway and Canada (Wittendorff, 2012).

As the MNE is unable to discriminate prices, its maximization problem is formulated as

$$\max_{\tilde{g}} \ \widetilde{\Pi} = (1-T)\bar{\pi} + (1-t)(\tilde{\pi}_u + \tilde{\pi})$$
$$= (1-T)\bar{\pi} + (1-t)[2(\tilde{g}-c)\tilde{q} + (\tilde{p}-\tilde{g})\tilde{q}].$$

The profits from selling inputs, $2(\tilde{g}-c)\tilde{q}$, are doubled because prices and quantities for the two downstream firms are the same.

From the FOC with respect to $\tilde{g}$, the following optimal input price is obtained:

$$\tilde{g} = \frac{1+c}{2} - \frac{1-c}{2(3+2b)}, \tag{10}$$

where the SOC trivially holds. Comparing this with the input prices under the host production scheme in the benchmark case, g and g_* defined in Eqs. (3) and (4), reveals that the input price in the ALP case falls between the two, i.e., $g < \tilde{g} < g_*$. In the benchmark case, the MNE exercises its market power against the local firm and sets the arm's length price higher than the marginal cost ($g_* > c$). For the downstream affiliate, the MNE sets the transfer price lower than the arm's length price to enhance competitiveness of the affiliate in the downstream market ($g < g_*$). In the ALP case, however, input prices cannot be discriminated so that the unique price reflects the two opposing motives. Therefore, the (absolute) magnitude of the strategic effect captured by the second term in Eq. (10) is smaller than the second term in Eq. (3).

The total post-tax profits in equilibrium are given by

$$\widetilde{\Pi} = (1-T)\bar{\pi} + \frac{(1-t)(1-c)^2}{3+2b}. \tag{11}$$

4.2. Separate-location Scheme

The quantities that the downstream firms choose are the same as in the co-location scheme:

$$\tilde{q}^S = \tilde{q}_*^S = \frac{1-\tilde{g}}{2+b} \quad (= \tilde{q}),$$

where the superscript S represents the separate-location scheme as before. Given these demand schedules, the MNE chooses an input price to maximize the total post-tax profits:

$$\max_{\tilde{g}^S} \ \widetilde{\Pi}^S = (1-T)[\bar{\pi} + 2(\tilde{g}^S - c)\tilde{q}^S] + (1-t)(\tilde{p}^S - \tilde{g}^S)\tilde{q}^S.$$

Solving the FOC yields the equilibrium input price:

$$\tilde{g}^S = \underbrace{\frac{1+c}{2} - \frac{1-c}{2(3+2b)}}_{\tilde{g}} - \frac{(1-c)(2+b)(T-t)}{(3+2b)[t-2(2+b)T+3+2b]}. \tag{12}$$

The SOC holds under the regularity condition (A1).[26] The third term in Eq. (12) captures the tax manipulation effect as seen in g^S defined in Eq. (6), and its sign depends only on $T-t$ because the denominator is positive under (A1). For $t < T$, the third term becomes negative, implying that the MNE reduces the input price to bring more profits to the downstream affiliate in the low-tax host country. Comparing $\tilde{g}^S$ with g^S reveals that the tax-manipulation effect is smaller in $\tilde{g}^S$ than in g^S.[27] Since the first two terms in $\tilde{g}^S$ equal $\tilde{g}$, it is observed that the ALP mitigates both the strategic and tax-manipulation effects. The input price is no longer an effective device for making the downstream affiliate competitive, or for shifting profits. Consequently, the input price in the ALP case falls between the transfer price and the arm's length price in the benchmark case, i.e., $g^S < \tilde{g}^S < g_*^S$, similar to the co-location

[26]The SOC is given by

$$\frac{d^2\tilde{\Pi}^S}{dt^2} = -\frac{2[t-2(2+b)T+3+2b]}{(2+b)^2} < 0,$$

which holds under (A1).

[27]To see this formally, we calculate the difference between the absolute coefficients of $T-t$ in $\tilde{g}^S$ and those

scheme.

The equilibrium total post-tax profits are calculated as

$$\widetilde{\Pi}^S = (1-T)\left[\bar{\pi} + \frac{(1-c)^2(1-T)}{t-2(2+b)T+3+2b}\right]. \tag{13}$$

4.3. Location Choice

Using the equilibrium total profits under the two different locations, we can determine in which country the MNE locates an upstream affiliate in the ALP case. From Eqs. (11) and (13), the profit difference is given by

$$\widetilde{\Pi} - \widetilde{\Pi}^S = \frac{(1-c)^2[t-(3+2b)T+2(1+b)](T-t)}{(3+2b)[t-2(2+b)T+3+2b]}.$$

The profits under the two schemes are illustrated in Fig. 3. It can be verified that the second term in the numerator and the denominator are positive under (A1), and thus the sign of the difference depends only on $T-t$. If $T-t>0$ and hence $\widetilde{\Pi}-\widetilde{\Pi}^S>0$ hold, the MNE chooses to locate the upstream affiliate in the host country.[28] If the opposite is true, it chooses to locate in the parent country. In other words, the upstream affiliate is always established in the low-tax country. In contrast to the benchmark case, the separate-location scheme is

---

in g^S:

$$\begin{aligned}
&\left|\frac{\partial \tilde{g}^S}{\partial(T-t)}\right| - \left|\frac{\partial g^S}{\partial(T-t)}\right| \\
&\quad = \frac{(1-c)(2+b)}{(3+2b)[t-2(2+b)T+3+2b]} - \frac{(2-b^2)(2+b)(1-c)}{2(2-b^2)[2t-(4-b^2)T+2-b^2]} \\
&\quad = -\frac{\Omega(2+b)(1-c)}{2(3+2b)(2-b^2)[t-2(2+b)T+3+2b][2t-(4-b^2)T+2-b^2]} < 0,
\end{aligned}$$

where $\Omega \equiv (4-4b-b^2+2b^3)t - 2(4-b^2)(4+b-b^2)T + 28 + 12b - 15b^2 - 4b^3 + 2b^4 > 0$.

[28] Notice that if $t>T$, then $\widetilde{\Pi}-\widetilde{\Pi}^S<0$ holds, implying that the MNE chooses the separate-location scheme. The upstream affiliate is located in the parent country simply for its low tax rate as in the benchmark case under $t>T$ (see footnote 23).

never optimal even if T is much higher than t. The input prices can neither be effectively used to enhance the competitiveness of the downstream affiliate, nor to shift profits, thereby reducing the benefit of choosing the separate-location scheme.

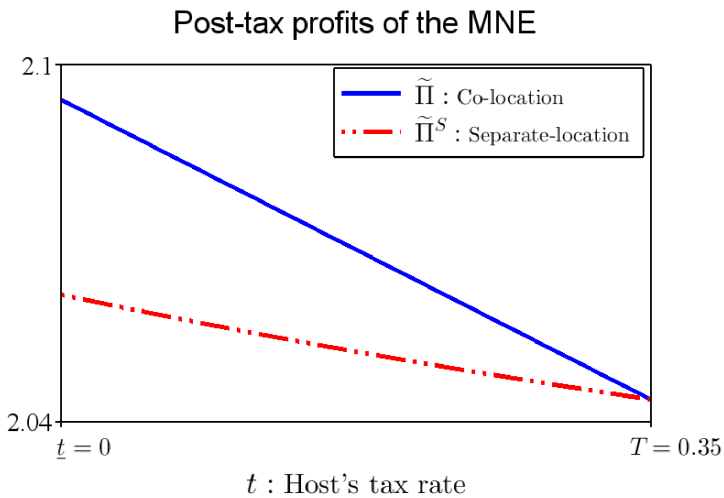

Fig. 3. Production location choice in the ALP case

Proposition 2 (ALP case). *Suppose the MNE sets equal input prices for its downstream affiliate and the local firm, and assume $t \leq T$ and the regularity condition (A1): $t > \underline{t}$. For any host's tax rate ($t \in (\underline{t}, T]$), the MNE always locates an upstream affiliate in the low-tax host country ("co-location").*

4.4. Extensions and Robustness

We have seen that the upstream affiliate may be located in the parent country (separate location) even if the parent's tax rate is higher than the host's tax rate (Proposition 1), and the imposition of the ALP may change the separate-location scheme to the co-location scheme (Proposition 2). One may wonder these results crucially depend on our simplified structure, where the intermediate inputs are supplied only by the upstream affiliate, and there is only one local rival in the downstream market. We briefly discuss the robustness of the results against two extensions by introducing (i) a local upstream rival and (ii) many downstream rivals. The detailed derivations are relegated to the Appendix.

Local Rival Firm in the Upstream Industry. In addition to the upstream affiliate, a local upstream rival in the host country is added. The upstream rival has the same marginal cost of c, supplies the same type of intermediate inputs as the upstream affiliate, and competes with the upstream affiliate in prices. Bertrand competition with homogeneous products leads both the two upstream firms to set their prices equal to or lower than their marginal cost. The upstream rival is unable to set its price lower than the marginal cost in order to earn non-negative profits. On the other hand, the upstream affiliate, if it is located in the parent country, is able to do so because its negative profits are compensated by the profits from different businesses $\bar{\pi}$. Thus, the MNE locates the upstream affiliate in the high-tax parent country as in Proposition 1, and takes the market share in the upstream industry.

In the ALP case, however, it is not profitable for the MNE to have an input price lower than the marginal cost. As both the related and unrelated downstream firms face the same input price, a lowered input price would make the local downstream rival as competitive as the downstream affiliate, thereby reducing the affiliate's profits. The ALP makes the separate-location scheme less effective than before and may change the location pattern as in Proposition 2.

Many Local Rival Firms in the Downstream Industry. We allow for many local downstream rivals, each of which produces its own variety of products. The greater number of downstream rivals yields more input sales. This implies that the downstream affiliate's profits relative to profits from local downstream rivals become less important in the MNE's total profits. The MNE now lays less emphasis on the role of transfer prices and relies more on input sales from many local downstream rivals. Thus, it tends to prefer the co-location scheme simply for the low tax rate in the host country. However, if the number of downstream rivals is not too large, Propositions 1 and 2 still hold.

5. The Impact of the ALP on Tax Revenues

It has been shown that the imposition of the ALP may change the location of upstream production from the parent to the host country. At first glance, this location change seems to enhance economic activities in the host and bring larger tax revenues. However, this is not true. It can be verified that for $t \in (\underline{t}, t^*)$, tax revenues under the co-location scheme in the benchmark case (without the ALP), denoted by $\widetilde{TR}_H$, are lower than those under the separate-location scheme in the ALP case, denoted by TR_H:[29]

$$
\begin{aligned}
&\widetilde{TR}_H < TR_H, \\
&\text{where } \ \widetilde{TR}_H = t(\tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_*) \\
&\qquad\qquad\quad = t \cdot 2(\tilde{p} - c)\tilde{q}, \\
&\qquad\qquad TR_H = t(\pi^S + \pi_*^S) \\
&\qquad\qquad\quad = t[(p^S - g^S)q^S + (p_*^S - g_*^S)q_*^S],
\end{aligned}
$$

where it is noted that $\tilde{p} = \tilde{p}_*$ and $\tilde{q} = \tilde{q}_*$. The tax base in the benchmark case consists of the profits of the two downstream firms $(\pi^S + \pi_*^S)$, while in the ALP case the tax base includes the profits of the upstream affiliate $(\tilde{\pi}_u)$ as well as the two profits $(\tilde{\pi} + \tilde{\pi}_*)$. If the MNE can discriminate between the transfer price and the arm's length price, the two input prices are chosen in a manner that the tax-manipulation effect strengthens the strategic effect. As a result, the downstream affiliate expands significantly, so that more goods are produced

[29] For t^* (defined in Eq. (9)) to be positive, we assume (A2), i.e., a sufficiently high T.

compared to the ALP case, i.e., $q^S + q_*^S > 2\tilde{q}$.[30] In fact, the imposition of the ALP helps the local rival firm expand ($\tilde{q}_* > q_*^S$), but discourages the production of the downstream affiliate ($\tilde{q} < q^S$).[31] The contraction of host production combined with a narrower price-cost margin results in smaller tax revenues.

In contrast, it can be verified that in most cases, the location change induced by the ALP *increases* tax revenues globally:

$$
\begin{aligned}
&\widetilde{TR}_W > TR_W,\\
&\text{where } \widetilde{TR}_W = T\bar{\pi} + t(\tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_*)\\
&\qquad\qquad = T\bar{\pi} + t \cdot 2[(\tilde{p} - \tilde{g}) + (\tilde{g} - c)]\tilde{q},\\
&\qquad\quad TR_W = T(\bar{\pi} + \pi_u^S) + t(\pi^S + \pi_*^S)\\
&\qquad\qquad = T[\bar{\pi} + (g^S - c)q^S + (g_*^S - c)q_*^S] + t[(p^S - g^S)q^S + (p_*^S - g_*^S)q_*^S].
\end{aligned}
$$

where tax revenues in the parent country are now taken into account. In the benchmark case, the upstream affiliate sets the transfer price lower than the marginal cost ($g^S < c$), and earns negative profits. The host country benefits from larger tax revenues at the expense of the parent country, but in general the benefit does not exceed the loss from a global viewpoint.[32]

[30] To see this formally, we have

$$
\begin{aligned}
&q^S + q_*^S - 2\tilde{q} = \frac{2\tilde{g} - (g^S + g_*^S)}{2+b} > 0,\\
&\to (5-2b)t - 2(2-b)T - 1 < 0,\\
&\to t < \frac{2(2-b)T + 1}{5-2b} \equiv t^q.
\end{aligned}
$$

There exists t satisfying the above inequality because it holds that $t^a < t^q < t^*$ and $t > \underline{t} \equiv \max\{t^a, t^b\}$ from (A1).

[31] Noting that $g^S < g_*^S$ and $\tilde{g} > g_*^S$, we have

$$
\tilde{q} - q_*^S = \frac{2g_*^S - bg^S - (2-b)\tilde{g}}{(2-b)(2+b)} > \frac{(2-b)(g_*^S - g)}{(2-b)(2+b)} > 0.
$$

Combining this result with $q^S + q_*^S > 2\tilde{q}$ gives $\tilde{q} < q^S$. This also implies that the gap between price and marginal cost is smaller in the ALP case than in the benchmark case: $\tilde{q} = \tilde{p} - \tilde{g} < p^S - g^S = q^S$.

[32] Only if the parent country has a extremely high tax rate which exceptionally expands the downstream affiliate, it is possible that the location change decreases global tax revenues. See the Appendix for the detailed conditions.

By imposing the ALP, the internal price is set higher than the marginal cost ($\tilde{g} > c$), which brings positive profits to the upstream affiliate in the host country and generally leads to greater tax revenues globally.

These results are summarized as follows (see the Appendix for the proof).

Proposition 3 (Tax revenues). *The imposition of the ALP changes the location of upstream production from the parent to the host country (from "separate location" to "co-location") if the international tax difference is large ($t \in (\underline{t}, t^*)$). This location change decreases tax revenues in the host country, but generally increases those globally.*

Considering the fact that countries adopt transfer pricing taxation to raise their tax revenues, the implementation of the ALP may give rise to an unintended consequence for countries with low corporate tax rates. Proposition 3 also suggests a conflict of interest in the ALP between low-tax and high-tax countries.[33] Although it is not part of the formal analysis, we conjecture that the results also apply to social welfare. The ALP limits the use of transfer price and thereby leads to higher prices of final goods, which reduces consumer surplus in the host country. Thus the location change caused by the ALP would lower not only tax revenues, but also social welfare (consumer surplus and profits as well as tax revenues) in the host country. For a full analysis on welfare in a related model but without location choice, we refer an independent work by Ishikawa et al. (2017).

6. Conclusion

This paper analyzed how corporate tax rates affect the production location choice of MNEs. One may think that internationally-mobile firms locate their production in low-tax countries,

[33] Similar results can be found in Yao (2013) in a different setting mentioned in the Introduction.

but this simple reasoning may not hold true for MNEs with multiple affiliates. MNEs attempt to reduce tax payments globally by manipulating transfer prices for intra-firm trade. Thus, they have an incentive to locate their upstream and downstream affiliates separately to exploit international tax differences. Contrary to the conventional wisdom, this paper shows that the upstream affiliate is likely to be located in the parent country, if its tax rate is much higher than the tax rate of the host country where the downstream affiliate is located.

With a view to preventing tax manipulations, the transfer pricing tax system requires MNEs to follow the ALP, where MNEs should not set different prices for related affiliates and unrelated firms. We have also analyzed the impact of the ALP on the location choice of MNEs. Under the ALP, MNEs are unable to fully utilize intra-firm transactions across borders for tax manipulation. The ALP makes the transfer pricing strategy less effective, and thus may change the location pattern from a separate-location to a co-location of upstream and downstream affiliates. This location change seems to bring greater tax revenues to the country hosting the two affiliates, but we have demonstrated that this is not true. In contrast to a separate location, a co-location in the host country does not provide the scope of profit shifting from the parent country, which leads to the loss of tax base in the host country. Owing to this, the host government may hesitate to implement the ALP strictly. However, the decrease in the host country's tax revenues due to the ALP is in general smaller than the increase in the parent tax revenues. As such, the ALP may be desirable globally.

We conclude by proposing possible extensions worth investigating. One extension is to allow taxes to be endogenously chosen by governments. In addition, one can think of many other policies to attract MNEs such as production and entry subsidies. Considering the policy importance of international tax planning, further analysis on different national tax systems is also needed such as the impact of a change from the separate accounting to the formula apportionment system, or the role of the advance pricing agreement. These issues are left to future research.

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Appendix

A.1. *List of Key Variables*

Benchmark	Co-location	Separate location
Internal price of the input	g	g^S (transfer price)
Arm's length price of the input	g_*	g_*^S
Price of the affiliate's final good	p	p^S
Price of the local firm's final good	p_*	p_*^S
Quantity of the affiliate's final good	q	q^S
Quantity of the local firm's final good	q_*	q_*^S
Pre-tax profits of the upstream affiliate	π_u	π_u^S
Pre-tax profits of the downstream affiliate	π	π^S
Pre-tax profits of the local firm	π_*	π_*^S
Total post-tax profits of the MNE	Π	Π^S

Arm's Length Principle (ALP)	Co-location	Separate location
Arm's length price of the input	$\tilde{g}$	$\tilde{g}^S$
Price of the affiliate's final good	$\tilde{p}$	$\tilde{p}^S$
Price of the local firm's final good	$\tilde{p}_*$	$\tilde{p}_*^S$
Quantity of the affiliate's final good	$\tilde{q}$	$\tilde{q}^S$
Quantity of the local firm's final good	$\tilde{q}_*$	$\tilde{q}_*^S$
Pre-tax profits of the upstream affiliate	$\tilde{\pi}_u$	$\tilde{\pi}_u^S$
Pre-tax profits of the downstream affiliate	$\tilde{\pi}$	$\tilde{\pi}^S$
Pre-tax profits of the local firm	$\tilde{\pi}_*$	$\tilde{\pi}_*^S$
Total post-tax profits of the MNE	$\widetilde{\Pi}$	$\widetilde{\Pi}^S$

We note that (i) in the ALP case, the internal price is equal to the arm's length price, (ii) the downstream firms produce one unit of final goods using one unit of intermediate inputs, and (iii) the pre-tax profits from the parent country $\bar{\pi}$ are always constant.

A.2. *Proof of Proposition 3*

Tax Revenues in the Host Country. Assuming the condition (A2), we will show that when $t \in (\underline{t}, t^*)$, tax revenues in the benchmark case, TR_H, are greater than those in the ALP case, $\widetilde{TR}_H$. It suffices to check the difference of taxable profits:

$$\widetilde{TR}_H - TR_H = t[\tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_* - (\pi^S + \pi_*^S)] < 0,$$
$$\rightarrow \tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_* - (\pi^S + \pi_*^S) \equiv \Gamma < 0.$$

If it is shown that (i) $\Gamma < 0$ holds at $t = t^*$ and (ii)Γ is increasing in t, we can conclude that Γ is positive for $t \in (\underline{t}, t^*)$. First we check (i):

$$\Gamma|_{t=t^*} = -\frac{B(1-c)^2}{4(2-b)^2(3+2b)^2} < 0,$$
$$\text{where} \quad B \equiv 4b^6 - 4b^5 + b^4 + 12b^3 - 46b^2 + 8b + 26 > 0.$$

(ii) requires the following condition:

$$\frac{d\Gamma}{dt} = -\frac{\partial(\pi^S + \pi_*^S)}{\partial g^S}\frac{dg^S}{dt} > 0,$$
$$\text{where} \quad \frac{dg^S}{dt} = \frac{(2-b)^2(2+b)(1-c)(1-T)}{2[2t-(4-b^2)T+2-b^2]} > 0,$$

noting that profits earned in the host under the ALP, $\tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_*$, are independent of transfer price and thus of tax rates. We only need to check that profits in the host in the benchmark case, $\pi^S + \pi_*^S$, are decreasing in transfer price, g^S:

$$\begin{aligned}
\frac{\partial(\pi^S + \pi_*^S)}{\partial g^S} &= \frac{2[b^2 g^S - 4bg_*^S + 4g^S - (b^2 - 4b + 4)]}{(2-b)^2(2+b)^2} \\
&< \frac{2[b^2 g_*^S - 4bg_*^S + 4g_*^S - (b^2 - 4b + 4)]}{(2-b)^2(2+b)^2} \\
&= \frac{2(g_*^S - 1)}{(2+b)^2} < 0,
\end{aligned}$$

where from the first to the second line we made use of $g^S < g_*^S$ and in the third line it holds that $g_*^S < 1$ from $c < 1$. Both (i) and (ii) are proved to be true and thus we complete the proof.

Tax Revenues in the World. We first show $g^S < c$ for $t \in (\underline{t}, t^*)$ while assuming (A2). $g^S < c$ requires the following condition:

$$g^S - c = \frac{(1-c)[(4-b)t - (4-b^2)T - b(1-b)]}{2[2t-(4-b^2)T+2-b^2]} < 0,$$
$$\rightarrow t < \frac{(4-b^2)T + b(1-b)}{4-b} \equiv t^g.$$

It can be verified that the above inequality holds for $t \in (\underline{t}, t^*)$ because

$$t^g - t^* = -\frac{(1-b)[(b^3 - 3b^2 + 4)T - b^3 + 7b^2 - 6b - 4]}{(4-b)(3-2b)} > 0,$$

noting that $b < 1$ and $T > \underline{T}$ from (A2).

We then show the following:

$$\begin{aligned}\widetilde{TR}_W - TR_W &= -T\pi_u^S + t[\tilde{\pi}_u + \tilde{\pi} + \tilde{\pi}_* - (\pi^S + \pi_*^S)] \\ &= -T\pi_u^S + t\Gamma \equiv \Delta > 0,\end{aligned}$$

where TR_W and $\widetilde{TR}_W$ are world tax revenues in the benchmark and the ALP cases, respectively.

Analogous to the previous case, if it is shown that (i)Δ is positive at $t = t^*$ and (ii)Δ is decreasing in t, we can conclude that $\Delta > 0$ holds for $t \in (\underline{t}, t^*)$. First we see (i):

$$\Delta|_{t=t^*} = \frac{\Omega(1-c)^2}{4(3-2b)(2-b)^2(3+2b)^2},$$

where $\Omega \equiv B_1 T + B_0$,

$$B_1 \equiv -(2-b)(4b^8 - 4b^7 - 23b^6 + 28b^5 + 36b^4 - 50b^3 - 14b^2 + 20b + 2) \in (-1, 10),$$

$$B_0 \equiv (1-b)(1+b-b^2)(4b^6 - 4b^5 + b^4 + 12b^3 - 46b^2 + 8b + 26) \in (0, 26).$$

B_1 becomes negative if the degree of differentiation b is close to unity (larger than 0.89). Therefore Ω can be negative if b is close to unity and T is sufficiently high. Except for such an extreme case, Ω is positive and thus $\Delta|_{t=t^*}$ is also positive.

To prove (ii), it suffices to show

$$\begin{aligned}\frac{d\Delta}{dt} &= -T\frac{d\pi_u^S}{dt} + \Gamma + t\frac{d\Gamma}{dt} \\ &< t\left(\frac{d\Gamma}{dt} - \frac{d\pi_u^S}{dt}\right) + \Gamma \\ &= t\frac{\partial(\pi^S + \pi_*^S - \pi_u^S)}{\partial g^S}\frac{dg^S}{dt} + \Gamma < 0,\end{aligned}$$

where from the first to the second line we have made use of $t < t^* < T$. As we have seen $dg^S/dt > 0$ and $\Gamma < 0$, we only need to check

$$\begin{aligned}\frac{\partial(\pi^S + \pi_*^S - \pi_u^S)}{\partial g^S} &= -\frac{2b(8-b^2)g_*^S - 2(12-b^2)g^S + (2-b)^2(bc+b+2c+4)}{(2-b)^2(2+b)^2} \\ &< -\frac{2b(8-b^2)g_*^S - 2(12-b^2)c + (2-b)^2(bc+b+2c+4)}{(2-b)^2(2+b)^2} \\ &= -\frac{4(1-c)(4-b)}{(2-b)^2(2+b)^2} < 0,\end{aligned}$$

noting that $g^S < c$ from the first to the second line. We complete the proof.

A.3. *Local Rival Firm in the Upstream Industry*

In the main text, the upstream affiliate is the only supplier of inputs. One may wonder this setting is crucial for the results, but it is not the case. We will see that the upstream affiliate may be located in the high-tax parent country ("separate location") in the benchmark case (Proposition 1) and the imposition of the ALP may change this location pattern (Proposition 2). We introduce a rival upstream firm in the host country. The rival upstream firm has the same marginal cost c as the MNE's upstream affiliate and competes with the affiliate in a Bertrand fashion. The timing proceeds in the same manner as in the text. First, the MNE chooses a location for upstream production. Then the MNE and the rival upstream firm set input prices. Finally the downstream affiliate and the rival downstream firm source the inputs and produce final goods.

As inputs produced by the two upstream firms are homogeneous, the downstream firms buy inputs from the lowest price supplier. Hence, the dominant strategy for the rival upstream is to set its input price equal to the marginal cost c. Considering this strategy of the rival upstream, the MNE sets input prices equal or lower than c. We need to modify the MNE's maximization problem so as to include inequality constraints on input prices.

Benchmark Case Let us first look at the separate-location scheme. The maximization problem for the MNE is modified as[34]

$$\begin{aligned}
&\max_{g^S, g^S_*} \ \Pi^S = (1-T)[\bar{\pi} + (g^S - c)q^S + (g^S_* - c)q^S_*] + (1-t)(p^S - g^S)q^S, \\
&\text{s.t.} \ \ g^S \leq c, \ \ g^S_* \leq c,
\end{aligned}$$

where the final good's price p^S and quantities (q^S, q^S_*) are defined in Section 3 and we assume that the MNE upstream affiliate takes all the input demand if its prices are equal to the ones of the rival upstream.

Letting λ and μ be the Lagrange multipliers for the constraints of $g^S \leq c$ and $g^S_* \leq c$ respectively, we solve the above problem to get

$$\begin{aligned}
&g^S = c - \frac{b^2(2-b)(1-c)}{4(2-b^2)} - \frac{(2+b)(2-b)^2(1-c)(T-t)}{2(2-b^2)[2t-(4-b^2)T+2-b^2]} < c, \\
&\lambda = 0, \\
&g^S_* = c, \\
&\mu = (1-c)(1-T)/2 > 0,
\end{aligned}$$

where we maintain the assumptions (A1) and $t \leq T$. As the multipliers are all non-negative, the equilibrium prices satisfy the Kuhn-Tucker conditions for optimization. g^S allows a similar interpretation to the one for the unconstrained optimal transfer price defined in Eq. (6). The first term is the base price equal to the arm's length price. The second and third

[34]We do not distinguish the notation of variables between the unconstrained problem in the text and the constrained problem here.

terms respectively represent the strategic and the tax-manipulation effects.

The associated post-tax profits are then given by

$$\Pi^S = (1-T)\left[\bar{\pi} + \frac{(1-T)(2-b)^2(1-c)^2}{8\{2t-(4-b^2)T+2-b^2\}}\right].$$

Under the co-location scheme in the benchmark case as discussed in Section 3, the MNE sets input prices higher than c in the unconstrained maximization problem, i.e., $g > c$ and $g_* > c$. Hence, in the constrained problem here, it can be confirmed that the MNE sets input prices equal to c, i.e., $g = c$ and $g_* = c$, and obtains the following post-tax profits:

$$\Pi = (1-T)\bar{\pi} + \frac{(1-t)(1-c)^2}{(2+b)^2}.$$

As easily seen, Π is smaller than Π^S at $t \in (\underline{t}, T]$. In other words, the MNE's optimal choice is that the upstream affiliate is always located in the parent country (separate location). Even when considering the rival upstream, our conclusion still holds; the upstream production may be located in the high-tax country for the strategic and tax-manipulation purposes.

ALP Case In the ALP case, the optimal input prices in the unconstrained problem discussed in Sections IV are never below the marginal cost c under the two schemes, i.e., $\tilde{g} > c$ and $\tilde{g}^S > c$. By the same reasoning as before, it can be confirmed that the constrained problem gives the input prices equal to the marginal cost, i.e., $\tilde{g} = c$ and $\tilde{g}^S = c$. Hence, the associated profits are identical with the one under the co-location scheme in the benchmark case, i.e., $\widetilde{\Pi} = \widetilde{\Pi}^S = \Pi$ at $t \in (\underline{t}, T]$. Unlike the benchmark case, the strategic and tax-manipulation effects disappear and the two countries are indifferent as to the location choice. In this generalized setting, we still see that the imposition of the ALP may change the location pattern as argued in the text.

A.4. *Many Local Rival Firms in the Downstream Industry*

As in A.3, we will see that our main conclusions are maintained in a more generalized setting than in the text. Consider N local rival firms in the downstream industry. The local rival firms are assumed to be symmetric and have the same marginal cost of c. If N is set to be unity, all the following results reduce to the corresponding results in the text.

The demand functions for the downstream affiliate and the local rival firm j are respectively given by

$$p = 1 - q - b\sum_{i=1}^{N} q_{*i},$$
$$p_{*j} = 1 - q_{*j} - b\left(q + \sum_{k\neq j}^{N} q_{*k}\right).$$

The following procedure is the same as in the text and we solve the problem backward. Taking into account the above demand schedules, the downstream firms choose quantities to maximize their own profits:

$$q = \frac{b[Ng_* + (1-N)g - 1] + 2(1-g_*)}{(2-b)(2+Nb)},$$
$$q_* = \frac{b(g-1) + 2(1-g_*)}{(2-b)(2+Nb)},$$

where we have used the symmetry to obtain $q_{*j} = q_*$ for all $j \in \{1, \ldots, N\}$.

Benchmark Case Given the equilibrium quantities the downstream firms choose, the MNE sets inputs prices to maximize its post-tax profits. In the co-location scheme, the equilibrium input prices are given by

$$g = \frac{1+c}{2} - \frac{(2-b)(1-c)}{2[2-b+Nb(1-b)]},$$
$$g_* = \frac{1+c}{2},$$

where the SOCs trivially hold. The second term in g is negative and captures the strategic effect as in Eq. (3) in the text. We can see that the internal price g is increasing in the number of downstream local rivals N. The more local rivals there are, the more inputs they source from the upstream affiliate. The upstream affiliate can earn more profits so that the profits of downstream affiliate are of less importance for the MNE. This is why as the number of local rivals increases, the MNE weakens the strategic effect and sets a higher internal price.

The total post-tax profits in equilibrium are calculated as

$$\Pi = (1-T)\bar{\pi} + \frac{(1-t)(1-c)^2[2+N-b(1+N)]}{4[2-b+Nb(1-b)]}.$$

The equilibrium input prices in the separate-location scheme are given by

$$g^S = \underbrace{\frac{1+c}{2} - \frac{(2-b)(1-c)}{2[2-b+Nb(1-b)]}}_{=g} \cdots$$

$$\cdots + \frac{(2-b)^2(2+Nb)(1-c)(t-T)}{2[2-b+Nb(1-b)][\{2+b(N-1)\}t-(2-b)(2+Nb)T+2-b+Nb(1-b)]},$$

$$\tilde{g}_*^S = \frac{1+c}{2},$$

where the SOCs require

$$\{2+b(N-1)\}t-(2-b)(2+Nb)T+2-b+Nb(1-b) > 0.$$

The total post-tax profits in equilibrium are calculated as

$$\Pi^S = (1-T)\left[\bar{\pi} + \frac{(1-c)^2\{Nt-(2-b)(1+N)T+2+N-b(1+N)\}}{4\{(2+b(N-1))t-(2-b)(2+Nb)T+2-b+Nb(1-b)\}}\right].$$

Under $t \leq T$, the third term in g is negative so that the tax-manipulation effect works in the same way as in Eq. (6).

Taking difference between the post-tax profits in both schemes gives

$$\Pi - \Pi^S = \frac{\Theta'(1-c)^2(T-t)}{4[2-b+Nb(1-b)][(2+b(N-1))t-(2-b)(2+Nb)T+2-b+Nb(1-b)]},$$

$$\text{where} \quad \Theta' \equiv (2-b+Nb)[2-b+N(1-b)]t+(2-b)(1+N)[2-b+Nb(1-b)]T\cdots$$

$$\cdots + N(1-b)[2+b(1-b)(1+N)].$$

The profit difference becomes zero at $t=T$ and $t=t'$ where t' is the solution of $\Theta'=0$. It can be confirmed that t' is in between $(\underline{t}, 1]$ if N is not sufficiently large.[35] In this case, we have $\Pi - \Pi^S < 0$ for $t \in (\underline{t}, t')$ and $\Pi - \Pi^S \geq 0$ for $t \in [t', T]$. We can conclude that the MNE chooses the separate location if the tax difference is large as in Proposition 1.

ALP Case Analogous to the benchmark case, the equilibrium input price under the co-location scheme becomes

$$\tilde{g} = \frac{1+c}{2} - \frac{1-c}{2[1+2N+Nb(1+b)]},$$

where the SOC trivially holds. It can be confirmed that the second term of the above expression, i.e., the strategic effect, is smaller than the counterpart of g and that $g < \tilde{g} < g_*$

[35]It always holds that $t' < T$. t' is decreasing in N if N is not sufficiently large so that it $t' > \underline{t}$ holds for not sufficiently large N.

holds as in the text. The total post-tax profits are given by

$$\widetilde{\Pi} = (1-T)\bar{\pi} + \frac{(1-t)(1-c)^2(1+N)^2}{4[1+2N+Nb(1+b)]}.$$

Turning to the separate-location scheme, the equilibrium input price becomes

$$\tilde{g}^S = \underbrace{\frac{1+c}{2} - \frac{1-c}{2[1+2N+Nb(1+b)]}}_{=\tilde{g}} \cdots$$

$$\cdots - \frac{(1-c)(1+N)(2+bN)(T-t)}{2[1+2N+Nb(1+b)][t-(1+N)(2+Nb)T+N(1+N)b+1+2N]}.$$

We can check that as long as N is not sufficiently large, the third term of the above expression, i.e., the tax-manipulation effect, is smaller than the counterpart of g^S and $g^S < \tilde{g} < g_*$ holds as in the text.

The total post-tax profits under the separate-location scheme are given by

$$\widetilde{\Pi}^S = (1-T)\left[\bar{\pi} + \frac{(1-T)(1-c)^2(1+N)^2}{4\{t-(1+N)(2+Nb)T+N(1+N)b+1+2N\}}\right],$$

where the SOCs require

$$t-(1+N)(2+Nb)T+N(1+N)b+1+2N > 0.$$

The profit difference then becomes

$$\widetilde{\Pi} - \widetilde{\Pi}^S = \frac{(T-t)(1-c)^2(1+N)^2[t-(1+2N+Nb+N^2b)T+N(1+N)b+2N)]}{4(1+2N+Nb+N^2b)[t-(1+N)(2+Nb)T+N(1+N)b+1+2N]},$$

which is positive because of the SOC. This implies that in the ALP case the MNE always chooses the co-location scheme as in Proposition 2.