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Multinationals, Profit Shifting and Retail Prices under Imperfect Competition

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Abstract

This paper studies the incidence of corporate taxes on retail prices set by multinational corporations (MNEs). We use a two-country model with two MNEs, each headquartered in a different country. Each MNE has a domestic producer that sells goods to a domestic and foreign affiliate that are retailers. We show that a marginal increase in the corporate tax in one country raises retail prices in that country but lowers retail prices in the other country. MNE profits decrease, more so in the country that does not increase its tax rate. Tax revenue rises in both countries, with a greater increase in the country that does not change its tax rate. Welfare may fall in the country that increases its tax rate.

1 Introduction

The body of literature on multinationals, profit shifting, and corporate taxation is extensive. For instance, the impact of profit taxes on multinational behavior has been studied in relation to various corporate tax systems (e.g., Nielsen et al. (2010); Bond and Gresik (2020)), debt shifting (e.g., Huizinga et al. (2008); Gresik et al. (2017)), abusive transfer pricing (Clausing (2003)), transfer price regulation (e.g., Kant (1988); Choi et al. (2020); Gauß et al. (2024)), corporate tax differentials (e.g., Horst (1971); Heckemeyer and Overesch (2017)), location of patents (Karkinsky and Riedel (2012)) and the amount of profits shifted (e.g., Dowd et al. (2017), Bilicka (2019) and Tørsløv et al., 2023). There is also a literature which analyses who bears the burden of profit taxes.[1] Early contributions, such as Harberger (1962), foud that the incidence of the corporate tax falls on firm owners in a closed economy. Under much less restrictive assumptions, a number of studies have shown that the burden of the corporate tax is shared by shareholders and employees (e.g., Mutti and Grubert (1985); Gravelle (2013); Suárez Serrato and Zidar, 2016, and Fuest et al. (2018)).

Most of the empirical literature on tax incidence presumes that consumers are not affected by profit taxation. At the outset, this seems reasonable. A higher profit tax implies that the owners will retain a smaller portion of the company's profit, but this does not mean that it would be optimal for the firm to change its sales quantity or prices. On the contrary, common wisdom tells us that profit-maximizing prices are independent of whether the owners keep a small or large share of the surplus.[2] However, in a recent study Baker et al. (2020) analyze the impact of corporate taxes on barcode-level product prices using linked survey and administrative data. Their study suggests that about half of the corporate tax incidence falls on product prices.

As far as we know, there does not exist any thorough theoretical analysis which explains why changes in profit taxes might affect consumer prices. The aim of this paper is provide such an explanation with regard to multinational enterprises (MNEs). We believe this is important both in its own right (e.g., to prevent dubious presumptions in empirical analysis) and with regard to policy recommendations Specifically, we study how international

[1] It is well known that differences in statutory corporate tax rates are significant drivers of profit shifting. See e.g., Grubert and Mutti (1991), Hines Jr and Rice (1994), Clausing (2003), Huizinga et al. (2008) and more recently Dowd et al. (2017). A survey is given in Beer et al. (2020).

[2] The reasoning is quite simply that a pure profit tax leads to a proportional after-tax reduction of marginal revenue and marginal cost, and therefore does not change the optimal price. A bit more formally; let a firm's after-tax profit be given by $\pi = (1 - t)(R(x) - C(x))$, where $t \in (0, 1)$ is the tax rate, and $R(x)$ and $C(x)$ are revenue and costs, respectively, as functions of output, x. Independent of the size of t, profit maximizing output is implicitly determined by $R'(x) = C'(x)$.

differences in profit taxes affect retail prices of MNEs that can shift profits through transfer prices. Note that international trade *per se* does not invalidate the common wisdom argument that profit-maximizing prices should be independent of how big is the share of profits the owners keep of the company surplus in each country.[3]

In this paper we demonstrate why differences in profit taxes across countries nonetheless might affect consumer prices and, by extension, the competitiveness of MNEs. We show this in a simple two-country model, where each country is host to a multinational enterprise. Each MNE has a domestic production unit that manufactures a final product which is sold to a domestic and a foreign affiliate, both of which operate as retailers. We assume that the MNEs produce imperfect substitutes, and that the retail subsidiaries in each country compete in prices.

A key finding within this simple set-up, is that a unilateral increase in the corporate tax rate of one country raises retail prices in that country but lowers retail prices in the other country. MNE profits decrease, and more so for the MNE that is located in the country where the tax rate is unchanged. We also show that a unilateral tax increase in one country might increase tax revenue in both countries, but that welfare nonetheless might fall in the country that raises its tax rate.

We contribute to the literature in several ways. First, we model competition between MNEs under imperfect competition, with price as the strategic variable. Second, we account for the possibility that MNEs may be multi-sided platforms that cater to different customer groups that are connected through inter-group network effects. Many of the largest and most influential industries in the global economy are served by such platforms.[4] Third, our analysis accounts for both a pure profit tax and tax distortions to the tax base, recognizing that taxable profit may differ from true economic profit, as is the case in many countries.

The starting point of our analysis is that the headquarters (HQ) of a multinational enterprise aims to maximize its world-wide after-tax profits. It does this by choosing profit-maximizing transfer prices to its domestic and foreign retail affiliates, who are delegated the authority to set consumer prices according to local competition. Similar assumptions are

[3]To see this formally, we can extend the example in footnote 2 to a setting with two countries. Thus, let $\pi = (1-t_1)(R_1(x_1) - C_1(x_1)) + (1-t_2)(R_2(x_2) - C_2(x_2))$, where the subscript corresponds to country 1 and 2, respectively. Other things equal, profit maximizing output is given from $R_i'(x_i) = C_i'(x_i)$, $i = 1, 2$, independent of absolute and relative sizes of t_1 and t_2.

[4]Multi-sided platforms can be found in a wide range of industries. Examples are the media industry (TV, Radio, newspapers, magazines, and news web portals) that targets readers/viewers and advertisers. Other examples are payment cards (merchants and cardholders), social media platforms (e.g., GOOGLE, Facebook, Instagram and X; users and advertisers), search engines (e.g., Crome; users and advertisers) and hardware and software systems (Mac OS, Windows; developers and end users).

made in (Schjelderup and Sorgard (1997), Nielsen et al. (2010) Gresik and Schjelderup (2024)). Delegation of decision-making is widespread in firms, and a substantial body of literature thoroughly documents and explores the extent of decentralization in various industries and within multinational enterprises (see e.g., Grandstand (1992), Almeida (1996), Papanastasiou and Pearce, 2005).[5]

The benefit of delegation is a central theme in the Industrial Organization (IO) literature, where a principal (the HQ) may benefit from hiring an agent (them retailers) and incentivize them to behave in a way that makes the rivals softer.[6] We consider a two-stage where the HQs of each MNE first announce their transfer prices. These are observed by all market participants. At the second stage, the retailers decide on the prices charged to consumers, taking transfer prices as given.[7]

Other things equal, the HQs at stage 1 have strategic incentives to set transfer prices that are significantly higher than marginal costs. Doing this, they can induce rivals to charge higher consumer prices. This raises profits for all firms. For this to work, the transfer prices set at stage 1 must be irreversible and observable for the rival. As discussed in Section 5, this strategy might be difficult to enforce in some markets. However, we show that our qualitative results survive even if each MNE's transfer prices cannot be observed by the rival (and thus cannot be used to increase prices). This indicates that our results are quite robust.

The rest of the paper is structured as follows. In Section 2 we set up our basic model, which features two identical MNEs operating in two identical countries. MNE_i has a production unit located in country i that manufactures a final good. This good is sold to two affiliated retailers - one domestically based (country i) and the other in country j. Section 3 studies the game where each HQs chooses the transfer prices at stage 1, and where the retailers set consumer prices at stage 2, after having observed each other's transfer prices. In Section 4, we investigate the effects of a unilateral change in corporate tax. Thereafter, in Section 5, we depart from the assumption that transfer prices are observable, and show that this does not change our qualitative results. Conclusions are found in Section 6.

[5] Graham et al. (2015) provide a survey of decision-making authority within firms.

[6] See, e.g., Vickers (1985), Sklivas (1987), Fershtman and Judd (1987), and Katz (1991). Bond and Gresik (2020) show the strategic effectiveness of public announcements even in the presence of private contract negotiations, such as those between a headquarters and the manager of an affiliate.

[7] As shown by Bulow et al. (1985) and Fudenberg and Tirole (1991), adopting a commitment strategy can allow the firm to influence its competitor's actions in a favorable way.

2 The model

We consider a model with two countries, $i = 1, 2$, each hosting a multinational enterprise (MNE). The multinational located in country i, MNE_i, has its headquarters (HQ) and a producer in that country. This producer manufactures a final product that is sold to a domestic affiliate and a foreign affiliate both of which operate as retailers. The domestic retail subsidiary of MNE_i is charged a price of q_{ii} per unit it acquires from the producer, and sells it to consumers at a retail price p_{ii}. The retail subsidiary has no other costs, and by selling x_{ii} units its pre-tax profit is equal to $\pi_{ii} = (p_{ii} + \eta - q_{ii})\, x_{ii}$.

The parameter η measures the strength if the network effect if the two competing multinationals operate in a two-sided market. If they do, they cater to two different customer groups. For example, in the case of a newspaper, the more readers it has, the higher the willingness of advertisers to pay for ad space. In our model, we simplify the network effect where increased newspaper sales generate additional revenue, surpassing the amount that could be obtained solely through the product's price by the variable η. In principle, η could vary between firms, but such differentiation will not qualitatively affect our results.

The profit tax in country i is equal to t_i and after-tax profit of the domestic retail subsidiary is

$$\Pi_{ii} = (1 - t_i)\, \pi_{ii}. \tag{1}$$

The foreign retail subsidiary of MNE_i is likewise charged the unit price q_{ij} from the production unit (the first subscript denotes the location of the MNE, and the second subscript the country where the good is consumed). Using parallel notation as above, we express the pre-tax profit for this retail subsidiary as $\pi_{ij} = (p_{ij} + \eta - q_{ij})\, x_{ij}$, and its after-tax profit as

$$\Pi_{ij} = (1 - t_j)\pi_{ij}. \tag{2}$$

Each MNE's producer faces constant marginal production costs equal to c, and we normalize all other costs to zero. Pre-tax profit for the production unit located in country i equals

$$\pi_{iP} = (q_{ii} - c)\, x_{ii} + (q_{ij} - c)\, x_{ij.} \tag{3}$$

We open up for the possibility that the tax base of MNE_i is more narrow than true profit by the parameter β_i so that tax deductible costs are equal to $t_i \beta_i c\,(x_{ii} + x_{ij})$, with $\beta_i \in (0, 1]$. The after-tax profit of the producer can be written as

$$\Pi_{iP} = (1 - t_i)\,(q_{ii}x_{ii} + q_{ij}x_{ij}) - c\,(x_{ii} + x_{ij}) + t_i\beta_i c\,(x_{ii} + x_{ij})\,. \tag{4}$$

The producer can deduct true costs against tax if $\beta_i = 1$, whereas incomplete tax deductibility of costs imply $0 < \beta_i < 1$.

Multinationals can shift profit from a high-tax country to a low-tax country. MNE_i cannot affect its tax bill by manipulating the transfer price between its the producer and the domestic retailer since both firms are subject to the same profit tax t_i. However, if $t_j > t_i$, it can reduce its tax bill by increasing q_{ij}, and vice versa if $t_i < t_j$.

To prevent an MNE from simply shifting all its profit to a low-tax country, the literature typically assumes that a firm incurs some tax concealment costs if it uses a transfer price that deviates from the true marginal production costs.[8] Following the approach in this literature, we could specify a concealment cost function $C(q_{ij})$, where the concealment costs are positive if q_{ji} differs from c (and larger the greater the deviation between the transfer price and the true marginal costs). Total profit after taxes for MNE_i could then be written as $\Pi_i = \Pi_{ii} + \Pi_{ij} + \Pi_{iP} + C(q_{ij})$.

In our main model, the MNEs will generally not use the export transfer price to shift all profits to the low-tax country, even in the absence of concealment costs (this changes with our model modification in section 5). To highlight the forces at work, and with no effect on the qualitative results, we shall therefore let $C(q_{ij}) = 0$ for all values of q_{ij}, so that profit after taxes for MNE_i are

$$\Pi_i = \Pi_{ii} + \Pi_{ij} + \Pi_{iP}.$$

Inserting the functional forms for $\Pi_{ii} + \Pi_{ij} + \Pi_{iP}$, after tax profit for MNE_1 is

$$\Pi_1 = \left[\sum_{j=1}^{2} (1 - t_j)\, p_{1j} x_{1j} - c\,(1 - \beta_1 t_1)\,(x_{11} + x_{12}) \right] + q_{12} x_{12}\,(t_2 - t_1)\,. \quad (5)$$

The term outside the square bracket in (5) captures the tax motive for setting q_{12} different from c; by increasing its export transfer price (q_{12}) by one unit, it changes its tax bill by $x_{12}(t_2 - t_1)$.

The profit function for MNE_2 is symmetric to that of MNE_1. Thus, instead of stating it here, we turn to the consumer side of the economy. Consumer demand in country i for the good sold by the domestic MNE, x_{ii}, is

$$x_{ii} = \alpha - p_{ii} + b p_{ji}, \quad (6)$$

and for the good sold by the foreign MNE, good x_{ji},

$$x_{ji} = \alpha - p_{ji} + b p_{ii}. \quad (7)$$

The goods are independent in demand if $b = 0$, while they are substitutes if $b > 0$. A sufficient condition for the existence of a stable equilibrium where

[8] See e.g., Kant (1988); Haufler and Schjelderup, 2000.

the products might be substitutes is that $b \in [0, 1)$. This is the case we focus on.

In what follows, we analyze the two-stage game, where the HQ of each MNE sets the transfer prices for its domestic and foreign retail subsidiaries at stage 1, and where the subsidiaries subsequently choose their profit-maximizing consumer prices at stage 2.

3 Solving stage 2 and stage 1 of the game

We use backward induction and start with the second stage where the subsidiaries take the transfer price as given and choose profit maximizing prices.

3.1 Stage 2. The subsidiaries choose profit maximizing prices.

Each retailer maximizes profits taking the transfer price as given. Solving $p_{ii} = \arg\max \Pi_{ii}$ and $p_{ji} = \arg\max \Pi_{ji}$, we find that the reaction functions that determine consumer (retail) prices in country i, are

$$p_{ii} = \frac{\alpha + q_{ii} - \eta}{2} + \frac{b}{2} p_{ji} \text{ and } p_{ji} = \frac{\alpha + q_{ji} - \eta}{2} + \frac{b}{2} p_{ii}.$$

These equations reveal that prices are strategic complements, and this effect is stronger the greater b is. In accordance with common knowledge, the tax parameters do not appear in the reaction functions.

Combing the two reaction functions yields

$$p_{ii} = \frac{2(\alpha - \eta + q_{ii}) + b(\alpha - \eta + q_{ji})}{4 - b^2} \text{ and } p_{ji} = \frac{2(\alpha - \eta + q_{ji}) + b(\alpha - \eta + q_{ii})}{4 - b^2}. \tag{8}$$

The price that each firm charges is increasing in its own marginal costs ($dp_{ii}/dq_{ii} = dp_{ji}/dq_{ji} = 2/(4 - b^2) > 0$). The fact that prices are strategic complements if $b > 0$ implies that prices are also increasing in the rival's marginal costs ($dp_{ii}/dq_{ji} = dp_{ji}/dq_{ii} = b/(4 - b^2) > 0$ if $b > 0$).

Given the second-stage equilibrium prices, we can use equations (6), (7) and (8) to write output in country i as

$$x_{ii} = \frac{2(\alpha + \eta - q_{ii}) + (\alpha - \eta + q_{ji})b - b^2(\eta - q_{ii})}{4 - b^2} \text{ and}$$
$$x_{ji} = \frac{2(\alpha + \eta - q_{ji}) + (\alpha - \eta + q_{ii})b - b^2(\eta - q_{ji})}{4 - b^2}.$$

3.2 Stage 1: The HQs choose transfer prices

At stage 1, the HQ of MNE_i chooses the transfer prices that maximize net after tax profit of the multinational enterprise:

$$\{q_{ii}, q_{ij}\} = \arg\max (\Pi_i = \Pi_{iP} + \Pi_{ii} + \Pi_{ij}). \tag{9}$$

We start by considering the transfer price that MNE_i sets for its domestic subsidiary. We have,

$$\frac{d\Pi_i}{dq_{ii}} = \frac{d\Pi_{iP}}{dq_{ii}} + \frac{d\Pi_{ii}}{dq_{ii}} + \frac{d\Pi_{ij}}{dq_{ii}},$$

where $d\Pi_{ij}/dq_{ii} = 0$.

For the producer we have;

$$\frac{d\Pi_{ip}}{dq_{ii}} = (1 - t_i)\left(x_{ii} + (q_{ii} - c)\frac{dx_{ii}}{dq_{ii}}\right). \tag{10}$$

If the HQ were to maximize profits for the producer, it would set (10) equal to zero. However, this is not optimal since it must also take into account how the profit level of the domestic subsidiary depends on the transfer price, that is,

$$\frac{d\Pi_{ii}}{dq_{ii}} = (1 - t_i)\left(\left(\frac{dp_{ii}}{dq_{ii}} - 1\right)x_{ii} + (p_{ii} + \eta - q_{ii})\frac{dx_{ii}}{dq_{ii}}\right). \tag{11}$$

Note that from equation (11), we have

$$\frac{d}{d\eta}\left(\frac{d\Pi_{ii}}{dq_{ii}}\right) = \frac{d}{d\eta}\left(\frac{d\Pi_i}{dq_{ii}}\right) = -2(1 - t_i)\frac{\left(2 - b^2\right)(1 - b)}{(2 + b)(2 - b)^2} < 0.$$

This means that the transfer price should be lower the greater the network effect (η) is. Intuitively, by reducing q_{ii}, the domestic subsidiary will sell more and thus raise higher revenue from the other side of the market. We also find that:

$$\frac{d}{d\beta_i}\left(\frac{d\Pi_i}{dq_{ii}}\right) = t_i c\frac{dx_{ii}}{dq_{ii}} < 0,$$

so that the optimal transfer price falls when more costs are tax deducible (transfer price is decreasing in β_i).

Having established that the domestic transfer price decreases with η and β_i, we shall for now set $\eta = 0$ and $\beta_1 = \beta_2 = 1$, as this makes it easier to interpret the subsequent equations. Doing so, and adding (10) and (11), we find the profit-maximizing transfer price charged to the retailer of MNE_i in county i is implicitly given by

$$\frac{d\Pi_i}{dq_{ii}} = (1 - t_i)\left(x_{ii}\frac{dp_{ii}}{dq_{ii}} + (p_{ii} - c)\frac{dx_{ii}}{dq_{ii}}\right) = 0 \tag{12}$$

Equation (12) makes it clear that the optimal transfer price does not depend on the domestic (or foreign) profit tax *per se*. This supports the traditional understanding that pure profits taxes do not affect equilibrium prices. The intuition behind (12) is straightforward: the headquarters should set the transfer price so that the marginal benefit of increasing q_{ii} ($x_{ii}dp_{ii}/dq_{ii} > 0$)

is equal to the marginal cost of reduced sales ($(p_{ii} - c)\, dx_{ii}/dq_{ii} < 0$). It is instructive to delve deeper into the last term. Since $x_{ii} = x_{ii}(p_{ii}, p_{ji})$, we have

$$\frac{dx_{ii}}{dq_{ii}} = \underbrace{\frac{\partial x_{ii}}{\partial p_{ii}} \frac{dp_{ii}}{dq_{ii}}}_{\text{Direct effect}} + \underbrace{\frac{\partial x_{ii}}{\partial p_{ji}} \frac{dp_{ji}}{dq_{ii}}}_{\text{Strategic effect}} . \tag{13}$$

The direct effect of increasing the transfer price is a rise in the retail price, which leads to a decrease in sales ($\partial x_{ii}/\partial p_{ii} = -1,\ dp_{ii}/dq_{ii} = 2/(4 - b^2) > 0$). Turning to the second term in (13) we note that since prices are strategic complements when $b > 0$, an increase in q_{ii} raises p_{ii}, which in turn prompts the rival to charge a higher price ($dp_{ji}/dq_{ii} = b/(4-b^2)$). This is the strategic effect;

$$\frac{\partial x_{ii}}{\partial p_{ji}} \frac{dp_{ji}}{dq_{ii}} = \frac{b^2}{4 - b^2};\ \frac{d}{db}\left(\frac{\partial x_{ii}}{\partial p_{ji}} \frac{dp_{ji}}{dq_{ii}}\right) > 0.$$

Raising the transfer price promts a stronger response from the competitior the higher b is. Put differently, the closer the products are as substitutes, the higher MNE_i will set the domestic transfer price to incentivize the foreign rival to charge a higher retail price in country i.

Solving (12) we find

$$q_{ii} = c + b^2 \frac{2\,(\alpha - c) + b(\alpha + bc)}{4(2 - b^2)} + \frac{b^3}{4\,(2 - b^2)} q_{ji}. \tag{14}$$

We can conclude that, other things equal, the equilibrium transfer price is greater than marginal production costs if $b > 0$. We also observe that q_{ii} increases with q_{ji} reflecting the strategic complementarity of consumer prices. We can state:

Lemma 1: *The domestic transfer price equals marginal costs if the products are independent ($b = 0$). If the products are imperfect substitutes ($b > 0$), the domestic transfer price increases with the export transfer price set by the foreign rival ($dq_{ii}/dq_{ji} > 0$).*

Turning to how the foreign multinational(MNE_j) sets the transfer price to its retailer in country i, we have;

$$\frac{d\Pi_{jP}}{dq_{ji}} = (1 - t_j)\left(x_{ji} + (q_{ji} - c)\,\frac{dx_{ji}}{dq_{ji}}\right) \tag{15}$$

and

$$\frac{d\Pi_{ji}}{dq_{ji}} = (1 - t_i)\left(\left(\frac{dp_{ji}}{dq_{ji}} - 1\right) x_{ji} + (p_{ji} - q_{ji})\,\frac{dx_{ji}}{dq_{ji}}\right). \tag{16}$$

Evidently, the marginal profit of increasing q_{ji} for MNE_j depends on the profit taxes in the two countries if $t_i \neq t_j$, because its producer and foreign

subsidiary are subject to different profit taxes. Consequently, the optimal export transfer price in this case depends on the profit taxes.

Solving $d\Pi_j/dq_{ji} = d\Pi_{jP}/dq_{ji} + d\Pi_{ji}/dq_{ji} = 0$, we have

$$q_{ji} = c + \frac{(2(\alpha - c) + b(\alpha + bc))\gamma_i}{\gamma_j} + b\frac{\gamma_i}{\gamma_j}q_{ii}, \tag{17}$$

where $\gamma_i = 4(t_i - t_j) + b^2(1 - 2t_i + t_j)$ and $\gamma_j = 2\left(2 - b^2\right)\left(2(1 + t_i) + b^2(t_j - t_i) - 4t_j\right)$.

Suppose that $b = 0$ in which case we have

$$q_{ji}|_{b=0} = c + \frac{t_i - t_j}{1 + t_i - 2t_j}(\alpha - c). \tag{18}$$

Equation (1/) and (18) constitute equilibrium values only if $(1 + t_i - 2t_j) > 0$.

Equation (18) shows that if the multinationals produce products that the consumers perceive as completely unrelated and the profit tax rate is higher in country i than in country j ($t_i > t_j$), then MNE_j will set the export transfer price higher than marginal costs, and vice versa if $t_i < t_j$. This is the pure profit shifting motive. We have:

Lemma 2: *The export transfer price increases with the domestic transfer price set by the foreign rival ($dq_{ji}/dq_{ii} > 0$) if $b > 0$, and depends on the profit tax in both countries if $t_i \neq t_j$. The export transfer price will differ from true marginal production costs even if the products are independent ($b = 0$) if $t_i \neq t_j$.*

Lemmas 1 and 2 together show that the transfer price to a domestic retailer differs from the transfer price to a foreign retailer.

The sizes of α and c do not matter for the qualitative result in the lemmas provided that $\alpha > c$. To simplify, we shall henceforth set $\alpha = 2$ and $c = 1$. By combing (14) and (17) we then have

$$q_{ii} = 1 + b^2\frac{2(1 + b)\left(2 - b^2\right)t_i - (2 + b)\left(4 + b - 2b^2\right)t_j + \left(4 + 2b - b^2\right)}{(1 + b)^{-1}\Omega_i} \tag{19}$$

and

$$q_{ji} = 1 + \frac{\left(4 + 2b - b^2\right)\left(2\left(2 - b^2\right)(t_i - t_j) + b^2(1 - t_j)\right)}{(1 + b)^{-1}\Omega_i}, \tag{20}$$

where $\Omega_i = 16(1 + t_i) - 32t_j - 20b^2t_i + 32b^2t_j + 6b^4t_i - 7b^4t_j - 12b^2 + b^4$.

Equations (19) and (20) are key to understanding the impact of a unilateral change in the corporate tax. This is the topic of the next section.

4 The effect of a unilateral increase in the corporate tax rate

The previous section established optimal retail prices and transfer prices. We start this section by analyzing how an increase in the corporate tax in country i affects the transfer prices to the subsidiaries in that country. From (19) and (20) we have

$$\frac{dq_{ii}}{dt_i} = (1-t_j)\,\frac{2b^3(1+b)\left(2-b^2\right)^2\left(4+2b-b^2\right)}{\Omega_i^2} > 0 \text{ for } b>0$$

and

$$\frac{dq_{ji}}{dt_i} = (1-t_j)\,\frac{8(1+b)\left(2-b^2\right)^3\left(4+2b-b^2\right)}{\Omega_i^2} > 0.$$

If country i increases its profit tax rate, it becomes less profitable to export to country i. Consequently, the foreign MNE wnats to shift profit to country j and increases its export transfer price ($dq_{ji}/dt_i > 0$). This prompts the domestic MNE in country i to do the same ($dq_{ii}/dt_i > 0$) if $b > 0$. However, since the tax increase affects the domestic transfer price only indirectly through the foreign export transfer price, we have $dq_{ii}/dt_i < dq_{ji}/dt_i$. As consumer prices are strictly increasing in the retail subsidiaries' marginal costs—both their own and, to a lesser extent, their rival's—it follows that a higher profit tax in country i increases consumer prices in that country, but more significantly for the imported good than for the one produced domestically. This leads us to our first main result (see Appendix A1 for a formal proof):

Proposition 1: *Suppose that country i raises its profit tax rate. As a result, the transfer prices to the retail subsidiaries in country i rises, leading to higher consumer retail prices. The retail price increase is more significant for the imported good than for domestically produced one.* ($dq_{ji}/dt_i > dq_{ii}/dt_i > 0$ and $dp_{ji}/dt_i > dp_{ii}/dt_i > 0$)

The tax increase in country i has repercussions in country j. The direct effect of a higher t_i is to make it profitable for MNE_i to reduce its export transfer price, and this induces MNE_j to reduce its domestic transfer price (given that $b > 0$) as well. Since the latter is only an indirect effect, we again find that the price effects are particularly great for the imported good. More precisely, we have (see Appendix A2 for a proof):

Proposition 2: *Suppose that country i raises its profit tax rate. As a result, the transfer prices to the retail subsidiaries in country j decrease, leading to lower retail consumer prices. The retail price reduction is more*

significant for the imported good than for the one domestically produced one ($dq_{ij}/dt_i < dq_{jj}/dt_i > 0$ and $dp_{ij}/dt_i < dp_{jj}/dt_i > 0$).

Figure 1 illustrates Propositions 1 and 2 for consumer prices. The horizontal axis measures the profit tax in country i, and the vertical axis measures consumer prices in the two countries. The red curves represent prices in country i, wile the blue curves represent prices in country j; solid curves illustrate prices of domestically produced goods, and dashed curves on imported goods. In the figure we have set $t_j = 0.2$ (and $b = 1/2$).[9] If $t_i = 0.2$ as well, all products are sold at the same price in the two countries. If $t_i > t_j$, on the other hand, the price level is higher in country i than in country j, and vice versa if $t_i < t_j$. Since domestic transfer prices only indirectly depend on international tax differences, the consumer price effects are greatest on imported goods in each country, as stated in the Propositions.

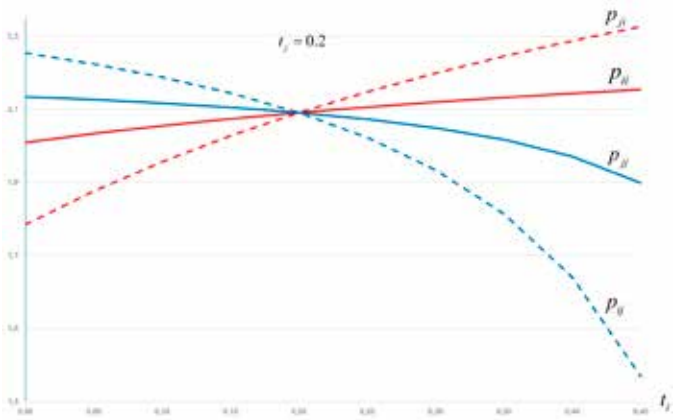

Figure 1: Consumer prices in country i (red curves) and country j (blue curves). Dashed curves: imported goods.

We now turn to how the MNEs are affected by an increase in t_i. First, the retail subsidiaries in country i become less profitable for two reasons; their marginal costs increase, and they must pay higher taxes. Therefore, it is unambiguously true that $d\Pi_{ii}/dt_i < 0$ and $\mathrm{d}\Pi_{ji}/dt_i < 0$. Additionally, it must also be true that the subsidiary of MNE_j is harmed more than its competitor, since it faces a more pronounced rise in marginal costs. Second, it is unambiguously true that the retail subsidiary of MNE_i in country j becomes more profitable. The reason is that higher profit tax in country i implies that MNE_i will shift profits to the the other country by reducing its export transfer price. This clearly benefits its foreign subsidiary, and with lower marginal costs it will charge a lower consumer price. This latter effect harms its rival, the domestic retail subsidiary of MNE_j.

[9] We use these parameter values ($b = 1/2$ and $t_j = 0.2$) in all subsequent figures.

We have (see Appendix A3 for a formal proof):

Proposition 3: *Suppose that the countries initially levy the same tax rate, $t_i = t_j$. A marginal increase in country i's profit tax will;*

a) reduce profits of MNE_j's retail subsidiaries in both countries ($d\Pi_{ji}/dt_i < 0$, $d\Pi_{jj}/dt_i < 0$), and

b) reduce profit of MNE_i's domestic retail subsidiary ($d\Pi_{ii}/dt_i < 0$), but increase profits of its foreign retail subsidiary ($d\Pi_{ij}/dt_i > 0$).

Since an increase in t_i increases profits for $MNE_i's$ foreign retail subsidiary, and at the same time makes its domestic subsidiary more competitive ($dq_{ji}/dt_i > dq_{ii}/dt_i > 0$), one might wonder whether MNE_i as a whole could benefit from the tax increase. We show that the answer is negative (if it were not, we might expect some multinationals to lobby for higher domestic profit taxes). More precisely, we can show that (see Appendix A4):

Proposition 4: *Suppose that the countries initially levy the same tax rates, $t_i = t_j$. A marginal increase in country i's profit tax reduces the profit level of both MNEs, with the foreign MNE experiencing the greatest reduction ($d\Pi_j/dt_i < d\Pi_i/dt_i < 0$).*

Propositions 3 and 4 state the consequences for profits of an increase in t_i in the neighborhood of $t_i = t_j$. Figure 2 demonstrates that these results hold even when countries levy different taxes: an increase in t_i increases profits for MNE_i's foreign retail subsidiary but reduces profits for its domestic retailer as well as both retailers of MNE_j. Both MNEs are harmed by higher taxes.[10]

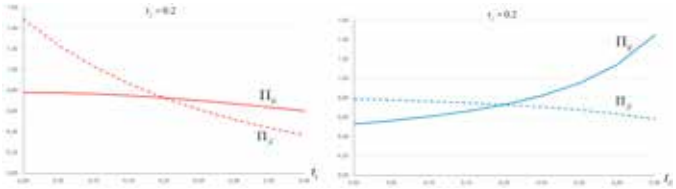

Figure 2: *Retailer profits in the two countries as functions of t_i.*

A primary purpose of this paper is to show that consumer retail prices and the competitiveness of MNEs may depend on profit taxes, which we treat as exogenously given. However, it is interesting to note the following (see Appendix A5 for a proof):

[10]We cannot verify that this is true for any feasible combination of parameter values, but we have not found any cases where it does not hold.

Proposition 5. *Suppose that both the countries initially levy the same profit taxes, $t_1 = t_2$. A marginal increase in one of the tax rates will increase tax revenue in both countries.*

Proposition 5 is illustrated in the left-hand side panel of Figure 3, which shows that both T_i and T_j increase with t_i in the neighborhood of $t_i = t_j$ (but tax revenue in country i eventually falls if t_i becomes sufficiently higher than t_j).This stark result might give the impression that if the countries, for some reason, have equal profit taxes (e.g., due to tax harmonization), then each country has an incentive to deviate and slightly increase its tax rate. However, from a normative point of view, government should care about welfare, and not tax revenue *per se*. Since consumer prices increase with the corporate tax rate, there is a clear trade-off between raising tax revenue and keeping consumer prices low.

In Appendix A5 we show that if initially $t_i = t_j$, then a marginal increase in t_i is more likely to reduce welfare in country i the greater is b (i.e., the better substitutes are the products). Setting $b = 1/2$, as in the figures above, we find that $dW_i/dt_i|_{t_i=t_j} > 0$ if $t < 0.198$ and $dW_i/dt_i|_{t_i=t_j} < 0$ if $t > 0.198$. This case is illustrated in the right-hand side panel of Figure 3; increasing t_i above $t_j = 0.2$ would increase tax revenue, but reduce welfare. However, since the present model is not suited for an analysis of tax competition between welfare maximizing countries, we will not pursue this issue further. We leave that for future research.

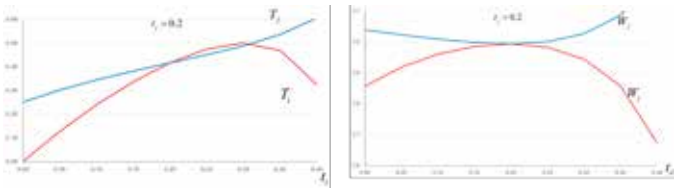

Figure 3: *Tax revenue and welfare as functions of the profit tax rate in country i.*

What role does the definition of the tax base play? Recall that if $\beta_i = 1$, all costs are tax deductible. If $0 < \beta_i < 1$ only a fraction of true costs are tax deductible. Starting from $t_1 = t_2 = t$, we relax the assumption that $\beta_1 = \beta_2 = 1$. Instead, we allow taxable profits to differ from true profits in at least one of the countries, say country i. The effect of broadening the tax base in country i (i.e., increasing β_i) is:

$$\frac{dp_{ii}}{d\beta_i} = \frac{dp_{ij}}{d\beta_i} = -\frac{\left(2-b^2\right)\left(4-b^2\right)}{\left(4+2b-b^2\right)\left(4-2b-b^2\right)}\frac{t}{1-t} \text{ and} \tag{21}$$

$$\frac{dp_{ji}}{d\beta_i} = \frac{dp_{jj}}{d\beta_i} = -\frac{2b\left(2-b^2\right)}{\left(4+2b-b^2\right)\left(4-2b-b^2\right)}\frac{t}{1-t} < 0 \text{ for } b > 0. \tag{22}$$

Equation (21) shows that increased tax deductibility of costs for MNE_i lowers its marginal costs leading to the same decrease in retail price by its retailers in country i and j. When retail prices are strategic complements, lower retail prices by one firm prompts the competitor to also reduce its retail prices, although to a lesser degree, as is clear from equation (22). We have:

Proposition 6. *Assume that $t_i = t_j$; $\beta_i < 1$; and $\beta_j \leq 1$. A broader tax base (a larger share of costs are tax deductible) in country i ($d\beta_i > 0$) leads to a reduction in all retail prices, with the reductions being more pronounced for retailers of MNE_i than for retailers of MNE_j.*

5 Non-observable transfer prices

Thus far, we have considered a two-stage game where the transfer prices of both MNEs are observed by retailers before they set consumer prices. MNEs have a mutual interest in ensuring this observability, as it softens competition and increases prices, as demonstrated above. Consequently, we might expect firms to implement a (perhaps tacit) signaling system to facilitate such *de facto* information exchange. However, the feasibility of this approach will likely vary across markets and may also depend on concerns about reactions from competition authorities, and how easily MNEs can adjust their transfer prices. This raises the question of whether the relationship between profit taxes and consumer prices we identified earlier critically depends on the observability of transfer prices. The answer is no; we will now show that observability is not a critical assumption.

When transfer prices are unobservable, we have a one-stage game where the headquarters set transfer prices and the retail subsidiaries set consumer prices simultaneously. In this game, the retailers' optimal consumer prices are still given by equation (8), which we repeat here for convenience:

$$p_{ii} = \frac{2(\alpha - \eta + q_{ii}) + b(\alpha - \eta + q_{ji})}{4 - b^2} \text{ and } p_{ji} = \frac{2(\alpha - \eta + q_{ji}) + b(\alpha - \eta + q_{ii})}{4 - b^2}$$

Each retailer sets a consumer price that increases with both its own transfer price and that of its rival (provided that $b > 0$). However, the equations describing the optimal transfer prices for the headquarters differ significantly between a one-stage and a two-stage game. Specifically, in the two-stage game, we found that the domestic transfer price of MNE_i and the export transfer price of MNE_j are strategic complements if $b > 0$. This means that if MNE_j increases its export transfer price to country i, q_{ji}, at stage 1, its retail subsidiary in that country will increase p_{ji} at stage 2. This strategic move is anticipated by the rival, who expects greater demand in

country i. In equilibrium, MNE_i will thus charge a higher transfer price to its domestic retail subsidiary as well (q_{ii} increases with q_{ji}).

However, this linkage disappears in a one-stage game where transfer prices are unobservable, neither MNE can use its transfer price to influence the demand its rival rationally expects. We find that the domestic transfer price in country i is always equal to the MNE's true marginal cost, while the export transfer price to country i increases with the profit tax of country i and decreases with the profit tax rate of country j (holding consumer prices fixed). Formally, solving $d\Pi_i/dq_{ii} = 0$ and $d\Pi_j/dq_{ji} = 0$ we find:

$$q_{ii} = c \text{ and } q_{ji} = c - \frac{(t_j - t_i)(\alpha - p_{ji} + bp_{ii})}{\phi}. \tag{23}$$

We can now derive equilibrium transfer prices and consumer prices by combining equation (8) and (23). This yields the equilibrium export transfer price

$$q_{ji} = c - \frac{(t_j - t_i)(2+b)[\alpha - c(1-b)]}{\phi(4-b) - (2-b)(t_j - t_i)}, \tag{24}$$

with consumer prices being equal to

$$p_{ii} = \frac{\phi(\alpha + c)(2+b) + (t_i - t_j)(\alpha(1+b) + c)}{\phi(4-b) - (2-b)(t_j - t_i)} \tag{25}$$

and

$$p_{ji} = \frac{\phi(\alpha + c)(2+b) + (t_i - t_j)(\alpha(2+b) + bc)}{\phi(4-b) - (2-b)(t_j - t_i)}. \tag{26}$$

From (24) we find

$$\frac{dq_{ji}}{dt_i} = -\frac{dq_{ji}}{dt_j} = \frac{\phi(4-b^2)(2+b)(\alpha + (1+b)c)}{(\phi(4-b) - (2-b)(t_j - t_i))^2} > 0, \tag{27}$$

while equations (25) - (26) yield

$$\frac{dp_{ii}}{dt_i} = -\frac{dp_{jj}}{dt_i} = \frac{b\phi(2+b)(\alpha - c + bc)}{(\phi(4-b) - (2-b)(t_j - t_i))^2} > 0 \text{ if } b > 0 \tag{28}$$

and

$$\frac{dp_{ji}}{dt_i} = -\frac{dp_{ji}}{dt_j} = \frac{2\phi(4-b^2)(2+b)(\alpha - c + bc)}{(\phi(4-b) - (2-b)(t_j - t_i))^2} > 0. \tag{29}$$

All other factors being equal, MNEs yield lower profits if they cannot observe each other's transfer prices before setting consumer prices. From equations (28) and (29), we deduce that the qualitative outcomes remain consistent in both the one-stage and two-stage game. Specifically, an increase in profit taxes in one country results in higher consumer prices within that country, particularly for imported products, and lower consumer prices in the other

country. In the one-stage game, the domestic transfer price is unaffected by potential differences in profit taxes. Apart from this, the qualitative results do not depend on whether firms can observe transfer prices prior to determining consumer prices.

6 Conclusion

The presence of multinational corporations in the global economy has grown over time, with intra-group trade accounting for a significant portion of world trade. For instance, in 1982, intra-group exports between parent firms located in the U.S and U.S affiliate exports to foreign parents constituted about one-third of the total value of U.S. exports. This proportion remained roughly the same in 2017 (Hines (2021)). Considering that U.S. exports accounted for 8 percent of GDP in 2017, intra-group trade, which is based on transfer prices that may deviate from arm's length prices, is undeniably significant.

In this paper, we have examined how competition between multinational corporations are influenced by changes in corporate tax. We have demonstrated that a marginal increase in the corporate affects consumer prices. In a two-country setting with two MNE operating in both countries we show that starting from a symmetric equilibrium we show that a marginal increase in the tax rate of country i reduces the profit levels of both MNEs, but more significantly for the MNE headquartered in country j. Tax revenue increases in both countries, with a more pronounced rise in country j. The effect on retail prices through transfer pricing behavior is profound: a tax increase by country i leads to a fall in transfer prices and retail prices in country j, but an increase in transfer prices and retail prices in country i.

Throughout the paper, we have assumed that MNEs do not keep two sets of books; where one transfer price is used for managerial incentives and another for tax savings on the same transaction. This, we believer, is largely consistent with standard practice. "Most MNEs insist on using one set of prices both for simplicity and to avoid the risk of multiple transfer prices being used as evidence in disputes with tax authorities" (Baldenius et al. (2004) p. 592). For instance, Czechowicz et al. (1982) reported that 89 percent of US MNEs use the same transfer price for both internal and external purposes. A survey by Ernst and Young (2003) indicated that over 80 percent of parent companies use a single set of transfer prices for both management and tax purposes. Their report added that "In many countries, management accounts are the primary starting point in determining tax liability, and differences between tax and management accounts are closely scrutinized" (p. 17). It should also be noted that our results do not hinge on the assumption that internal and external transfer prices are identical. What matters is that they are not completely independent of each other.

Our study has several limitations. The assumption of symmetry across countries and firms restrict our analysis, as does our reliance on a linear demand function. While future research may benefit from relaxing these assumptions, we believe that the core insights derived from our analysis will remain fundamentally unchanged.

7 Appendix

Appendix A1. Proof of Propositions 1.

Using equations (8), (19) and (20) we find that

$$dq_{ii}/dt_i = 2b^3\left(1+b\right)\left(2-b^2\right)^2\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_i^2 > 0 \text{ for } b>0$$

and

$$dq_{ji}/dt_j = 8\left(1+b\right)\left(2-b^2\right)^3\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_i^2 > 0$$

$$=> \frac{dq_{ji}/dt_i}{dq_{ii}/dt_i} = 1+\frac{\left(4-2b-b^2\right)\left(2+b\right)}{b^3} > 1.$$

This further implies

$$dp_{ii}/dt_i = 4b\left(1+b\right)\left(2-b^2\right)^2\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_i^2 > 0 \text{ for } b>0$$

and

$$dp_{ji}/dt_i = 2\left(1+b\right)\left(2-b^2\right)^2\left(4-b^2\right)\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_i^2 > 0$$

$$=> \frac{dp_{ji}/dt_i}{dp_{ii}/dt_i} = 1+\frac{\left(4-2b-b^2\right)}{2b} > 1.\ Q.E.D.$$

Appendix A2. Proof of Propositions 2.

Equations (8), (19) and (20) yield

$$dq_{ij}/dt_i = -8\left(1+b\right)\left(2-b^2\right)^3\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_j^2 < 0$$

$$dq_{jj}/dt_i = -2b^3\left(1+b\right)\left(2-b^2\right)^2\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_j^2 < 0 \text{ for } b>0$$

$$>= \frac{dq_{ij}/dt_i}{dq_{jj}/dt_i} = 1+\frac{\left(4-2b-b^2\right)\left(2+b\right)}{b^3} > 1$$

From this we can deduce

$$dp_{ij}/dt_i = -2\left(1+b\right)\left(2-b^2\right)^2\left(4-b^2\right)\left(4+2b-b^2\right)\left(1-t_j\right)/\Omega_j^2 < 0$$

and

$$dp_{jj}/dt_i = -4b\left(1+b\right)\left(2-b^2\right)^2\left(4+2b-b^2\right)\left(1-t_k\right)/\Omega_j^2$$

$$=> \frac{dp_{ij}/dt_i}{dp_{jj}/dt_i} = 1+\frac{4-2b-b^2}{2b} > 1$$

Appendix A3. Proof of Proposition 3.

Inserting for equilibrium prices from stage 1 and 2 into the profit functions and differentiating with respect to t_i around $t_i = t_j$ we find that in country i we have

$$\left.\frac{d\Pi_{ii}}{dt_i}\right|_{t_i=t_j} = A = -\frac{\left(2-b^2\right)^2(1+b)^2\left(16\left(1-b+b^3\right)-\left(12-b^2+4b^3\right)b^2\right)}{(4+2b-b^2)(4-2b-b^2)^3} < 0 \text{ and}$$

$$\left.\frac{d\Pi_{ji}}{dt_i}\right|_{t_i=t_j} = B = -\frac{\left(2-b^2\right)^2(1+b)^2\left(48-52b^2+13b^4\right)}{(4+2b-b^2)(4-2b-b^2)^3} < 0.$$

For country 2 we likewise find

$$\left.\frac{d\Pi_{ij}}{dt_i}\right|_{t_i=t_j} = E = \frac{4\left(2-b^2\right)^3\left(4-3b^2\right)(1+b)^2}{(4+2b-b^2)(4-2b-b^2)^3} > 0 \text{ and}$$

$$\left.\frac{d\Pi_{jj}}{dt_i}\right|_{t_i=t_j} = F = -\frac{4b\left(2-b^2\right)^4(1+b)^2}{(4+2b-b^2)(4-2b-b^2)^3}.$$

Appendix A4. Proof of Proposition 4.

Inserting for equilibrium prices from stage 1 and 2 into the profit functions and differentiating with respect to t_i around $t_i = t_j$ we find that in country i we have

$$\left.\frac{d\Pi_{i}}{dt_i}\right|_{t_i=t_j} = C = -\frac{\left(2-b^2\right)(1+b)^2\left(8-4b-2b^2+6b^3+b^4\right)}{(4-2b-b^2)^2(4+2b-b^2)} < 0 \text{ and}$$

$$\left.\frac{d\Pi_{j}}{dt_i}\right|_{t_i=t_j} = D = -\frac{\left(2-b^2\right)^2(1+b)^2\left(4+6b+b^2\right)}{(4-2b-b^2)^2(4+2b-b^2)} < 0.$$

Appendix A5. Proof of Proposition 5.

Tax revenue in country $i = 1, 2$ with $\beta_i = \beta_j = 1$ is equal to $T_i = t_i(q_{ii} - c)x_{ii} + t_i(q_{ij} - c)x_{ij} + t_i\pi_{ii} + t_i\pi_{ji}$. Inserting for equilibrium prices and differentiating yield

$$\left.\frac{dT_i}{dt_i}\right|_{t_i=t_j} = \frac{4\left(2-b^2\right)(1+b)^2}{(4-2b-b^2)^2} > 0 \text{ and}$$

$$\left.\frac{dT_j}{dt_i}\right|_{t_i=t_j} = \frac{2\left(2-b^2\right)^2(1+b)^2\left(32-8b-40b^2+4b^3+13b^4\right)}{(4-2b-b^2)^3(4+2b-b^2)}\frac{t}{1-t} > 0.$$

Welfare in country i equals $W_i = T_i + \Pi_i + CS_i$, where CS_i is consumer surplus. Consumer surplus for the domestically produced good is $S_{ii} =$

$(2 + bp_{ji} - p_{ii})x_{ii} - x_{ii}^2/2$, while it is $S_{ji} = (2 + bp_{ii} - p_{ji})x_{ji} - x_{ji}^2/2$ for the imported good. Using $CS_i = CS_{ii} + CS_{ji}$ and differentiating we find

$$\left.\frac{dW_i}{dt_i}\right|_{t_i=t_j} = \frac{1}{1-t}\frac{\left(2-b^2\right)^2(1+b)^2\left(80-92b^2+25b^4\right)}{(4+2b-b^2)(4-2b-b^2)^3}(b^*-t) > 0 \text{ if } b^* > t,$$

where $b^* = b\frac{24+8b-16b^2-7b^3+2b^4}{-92b^2+25b^4+80}$. Note that $\frac{db^*}{db} = 2\frac{960+640b-816b^2-1120b^3+236b^4+444b^5-76b^6+25b^8}{(-92b^2+25b^4+80)^2} > 0$ for $b \in (0,1)$. At $b = 1/2$ we have $b^* = \frac{186}{937} \approx 0.198\,51$. Increasing t_i slightly above $t_i = t_j = 0.2$ thus reduces welfare even though tax revenue increases.

Let us now see how the MNEs are affected by an

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This paper studies the incidence of corporate taxes on retail prices set by multinational corporations (MNEs). We use a two-country model with two MNEs, each headquartered in a different country. Each MNE has a domestic producer that sells goods to a domestic and foreign affiliate that are retailers. We show that a marginal increase in the corporate tax in one country raises retail prices in that country but lowers retail prices in the other country. MNE profits decrease, more so in the country that does not increase its tax rate. Tax revenue rises in both countries, with a greater increase in the country that does not change its tax rate. Welfare may fall in the country that increases its tax rate.

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