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Discrete Investment and Tax Competition when Firms shift Profits

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Discrete Investment and Tax Competition when Firms shift Profits

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Abstract

In this paper, we model the tax setting game between two revenue maximizing countries which compete for the location of a single production plant owned by a multinational firm. We introduce the possibility that the multinational can shift a fraction of its profits out of the country where the production plant is located. In this framework, it is investigated how a change in the costs of profit shifting affects equilibrium tax rates. We show that in most cases, equilibrium tax rates of the two countries will be higher under profit shifting than without. Unless profit shifting does not become too easy, the strategic adjustment of profit tax rates will typically harm the multinational firm.

Keywords: tax competition, profit shifting, multinational enterprises, discrete investment
JEL Classification: F23, H25, H32

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1. Introduction

The last decades have seen a significant rise in the number of multinational firms worldwide. Tax authorities face several problems when trying to raise revenue from these highly mobile firms. First of all, international competition for real investment of multinationals creates downward pressure on corporate tax rates. Moreover, since multinationals are known to shift profits to low tax countries, governments are prone to compete for shifted profits as well.

The literature so far has only just begun to recognise the potential implications of such "multiple" competition for multinational firms and its interaction. For example, Haufler and Schjelderup (2000) show, that if multinational firms can shift profits, it becomes optimal for governments to cut statutory tax rates while at the same time broadening the tax base, leaving the effective tax rate unchanged. More recent studies explore how income shifting may reduce the cost of capital in high tax countries, thereby making it a more attractive location for foreign investments. In this context, Peralta et. al (2006) as well as Bucovetsky and Haufler (2005) argue that it may be optimal for governments to be lax when monitoring the profit shifting activities of multinational firms. As Hong and Smart (2005) show, such a lax monitoring policy may enable the high tax country even to increase its tax rate compared to the case without profit shifting.

The analysis of Hong and Smart (2005), however, assumes that multinational profit shifting activities, beside the monitoring policy, are only determined by the host country's tax rate. Therefore, they neglect the potential effect on the optimal tax rate set by the low tax country in which profits are shifted. These effects are taken into account in the model of Stöwhase (2005) by assuming a functional relationship between the fraction of total profits shifted and the existing tax rate differential between the two countries. For the case of revenue maximizing governments and marginal investment decisions, this study shows that statutory tax rates of the two countries will converge in equilibrium when obstacles for profit shifting vanish. However, due to the complexity of the underlying model, the question whether these tax rates are lower or higher than those set in the case without profit shifting can not be answered unambiguously.

This is the aim of the present paper. We model profit shifting between a high tax and a low tax country in a way very similar to Stöwhase (2005), but instead of marginal investments where firms may choose to produce simultaneously in the low tax as well as in the high tax country, we consider the case where the multinational firm has to choose between two mutual exclusive locations for a discrete investment project. Discrete investments do in fact play a similar role in statistics of foreign direct investment than marginal investments. The advantage modelling discrete investment decisions is, however, that it simplifies the analysis a lot. In this framework, it is investigated how an exogenous change in the costs of profit shifting affects the tax rate of the competing countries. As we will show, although it may lead the high tax country to increase its tax rate, a reduction in profit shifting costs will always decrease revenues for this country. The low tax country, on the other hand, will benefit from increased profit shifting as long as it is not too easy. Our main result, however, is that a reduction in the costs of profit shifting will typically harm the multinational firm. Only if profits can be shifted rather easy and costless from one country to the other, the firm will be better off compared to the case without profit shifting.

The remainder of the paper is organized as follows. Section 2 presents the basic model. In section 3, we analyse how equilibrium tax rates and tax revenues change due to an exogenous variation in the costs of profit shifting. Results are shortly discussed in section 4. Section 5 concludes.

2. Model

2.1. General Framework

We consider two countries A and B which compete for a single multinational firm. The firm produces in only one of the two countries, from now on referred to as home country, where all its profits are generated, while serving the other market by a sales-office which generates zero profits. It is assumed that the firm is a monopolist in both markets. When locating its production facility in country A, pre-tax profits generated by the production facility are given by π_A. We normalise these profits to unity. Moreover, we assume that when locating the production facility in country A, pre-tax profits exceed those the multinational obtains from locating production in country B,

$\pi_A = 1 > \pi_B$. There may be several reasons for the different levels of pre-tax profits in the two countries: One could possibly think of the case where there exist transport costs. In this case market size plays a crucial role and $\pi_A > \pi_B$ implies that country A is the larger of the two markets. Alternatively, it can be assumed that both markets are equally sized but that country A is technological more advanced such that production costs are rather low there.

Countries A and B levy a source tax with rate t_A, respectively t_B, on the profits declared within its borders. For the sake of simplicity, we assume that when setting tax rates, countries maximize their tax revenue only. This assumption can be justified when governments face severe revenue shortfalls, such that taxation is sufficiently more important than private consumption. Alternatively we can interpret the objective of revenue maximization as having a Leviathan-type of government. As Kanbur and Keen (1993) argue, this assumption is comparable to conventional welfare maximization if there is a high marginal valuation of public goods.

2.2. The case without profit shifting

Let us first consider the case where the multinational firm is not able to shift profits from one location to the other. Countries compete for the location of the production facility, which is the exclusive source of revenue in this case. When locating in country A, after-tax profits of the firm are given by $\Pi_A = 1 - t_A + 0$, when locating in country B by $\Pi_B = (1 - t_B)\pi_B + 0$, respectively. Since countries maximize tax revenue only, the lowest tax rate country B is willing to offer to the multinational is $t_B = 0$. Country A's best response to this offer is given by:

$$t_A < 1 - \pi_B$$

which is obviously positive since we have $\pi_B < 1$. Therefore, the firm locates its production facility in country A where pre-tax profits are maximal. Country A, in turn, extracts its location rent by setting a positive tax rate.

2.3. Introducing profit shifting

Now let us assume that the multinational firm may, at some costs, further reduce its tax payments in the high tax country by declaring a fraction α of its profits in the low tax country B where the sales-office is located. Total profits are then given by:

$$\Pi_A = (1-t_A)(1-\alpha) + (1-t_B)\alpha - \theta(\alpha,\beta) \qquad (1)$$

where $\theta(\alpha,\beta)$ are the (non-deductible) costs of profit shifting.

We follow Stöwhase (2005) in assuming that the costs of profit shifting are given by the quadratic function:

$$\theta(\alpha,\beta) = \frac{\beta\alpha^2}{2}. \qquad (2)$$

The parameter $\beta \in [0;\infty]$ is exogenously given and describes the general costs for misreporting activities. This parameter can be related to the degree of globalization or to the tax codes of the two countries. As can be seen from (2), costs increase with β. Accordingly, low values of β may either depict a situation in which increased globalization creates generous opportunities for the firm to undertake misreporting activities or a situation where there exist a number of loopholes in the national tax codes that make it rather easy to shift profits.

When choosing the optimal fraction of profits to be shifted into the low tax country, the firm compares the higher tax savings from increasing α, with the costs of increasing it. Substituting equation (2) in equation (1) and differentiating with respect to α, we get:

$$\alpha = \frac{t_A - t_B}{\beta}. \qquad (3)$$

The optimal degree of profit shifting therefore increases with the tax rate differential between country A and country B and decreases with the cost parameter β. Using this result, we are able to give a more clear-cut interpretation of the parameter β as well. Differentiating α with respect to the tax rate differential $\Delta t = t_A - t_B$, we get $\beta = 1/(d\alpha/d\Delta t)$. It is therefore the reciprocal of the tax-base change caused by an adjustment in tax rates. While the tax base reacts rather inelastic to changes in tax rates for $\beta > 1$, it is very sensitive to changes in tax rates if β approaches zero.

2.4. Governments choice of tax rates under profit shifting

When introducing profit shifting, the situation for country B changes significantly. While revenues were zero in the case without profit shifting for any positive tax rate chosen by country B, profits shifted into the country can be taxed now with some positive tax rate t_B. When setting t_B, however, country B has to bear in mind that, according to (3), the fraction of profits that can be taxed decreases as the tax differential between country A and B decreases. If the multinational still locates in country A but shifts profits into country B, revenue of the latter is given by:

$$R_B = \frac{t_A - t_B}{\beta} t_B . \tag{4}$$

Differentiating equation (4) with respect to t_B, we derive the revenue-maximizing tax rate of country B:

$$t_B = \frac{t_A}{2} . \tag{5}$$

Hence, for the specific cost function given in equation (2), country B maximizes tax revenues from shifted profits by setting a rate exactly half of that levied in country A. This simplifies equation (3) to $\alpha = t_A / 2\beta$.

For country A, we observe two opposite effects as well: While, on the one hand, the positive tax rate set by country B likewise allows country A to increase its tax rate (locational effect), it may be, on the other hand, optimal to decrease t_A in order to limit profit shifting (profit shifting effect). Revenue for country A is given by $R_A = (1-\alpha)t_A$. If country B acts according to equation (5) and maximizes revenue from the production facility located in A, substituting for α gives:

$$R_A = \left(1 - \frac{t_A}{2\beta}\right) t_A . \tag{6}$$

Analogous to the case of country B, we calculate the revenue maximizing tax rate by differentiating equation (6) with respect to t_A and get:

$$t_A = \beta \,. \tag{7}$$

For any given value of β, equation (7) defines an upper limit for the tax rate chosen by country A. If, for example, β is low and the tax base reacts very sensitive, t_A has to be small in order to limit the outflow of profits to country B. The profit shifting effect dominates. For large values of β, on the other hand, the locational effect will dominate and country A can set a rather high tax rate.[1] This upper limit defined by equation (7), however will only be reached in those cases, in which country B acts according to equation (5).

Effectively, there exists a severe constraint on the tax rate set by country A: If t_A under profit shifting is larger than in the case without, country B may deviate from the optimal tax rate given by equation (5). By setting a lower tax rate, t_B^*, it will possibly attract the production facility such that it can tax all profits of the multinational firm within its borders. To exclude this possibility, country A has to choose its tax rate such that the revenue country B gets under profit shifting is at least as high as that under the alternative strategy where country B attracts the production facility directly:

$$\frac{t_A - t_B}{\beta} t_B \geq t_B^* \pi_B \,. \tag{8}$$

To solve this problem, we have to calculate t_B^* first. The multinational firm locates in country B if it holds that:

$$(1-t_A)(1-\frac{t_A}{2\beta}) + \left(1-\frac{t_A}{2}\right)\frac{t_A}{2\beta} - \frac{t_A^{\,2}}{8\beta} < (1-t_B^*)\pi_B \,. \tag{9}$$

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[1] Note that, for $\beta > 1$, the upper limit for t_A will exceed one. A constraint on t_A is given only by the condition that after-tax profits of the multinational firm have to be non-negative. This condition will hold as long as the effective tax rate of the multinational firm together with the costs of profit shifting do not exceed one. Substituting for α and t_B in equation (1), we get that this condition is fulfilled as long as it holds that $1 \leq t_A \leq 4\beta - \left(16\beta^2 - 8\beta\right)^{0.5}$.

The left hand side of equation (9) depicts profits of the multinational firm if it locates its production facility in country A. It can be obtained from using (5) and (3) in equation (1). Profits of the multinational firm when choosing country B as its home country are given by the right hand side of equation (9). Solving (9) for t_B^* and substituting in equation (8) gives:

$$\frac{t_A - t_B}{\beta} t_B \geq \pi_B - \left[(1-t_A)(1-\frac{t_A}{2\beta}) + (1-\frac{t_A}{2})\frac{t_A}{2\beta} - \frac{t_A^{\ 2}}{8\beta} \right].$$

This expression simplifies to:

$$t_A^{\ 2} - \frac{8}{3}\beta t_A + \frac{8}{3}\beta(1-\pi_B) = 0 \tag{10}$$

The solution to the quadratic problem in equation (10) is given by:

$$t_A^{\ C} = \frac{4}{3}\beta - \left(\frac{16}{9}\beta^2 - \frac{8}{3}\beta(1-\pi_B) \right)^{0.5} \tag{11}$$

where $t_A^{\ C}$ is the constrained tax rate chosen by country A.[2] This constrained tax rate is defined for any $\beta > 3/2(1-\pi_B)$. For smaller values of β, the bracket term in equation (11) becomes negative. We can ignore this mathematical problem, however, since the constraint on t_A is not binding any more once the bracket term in (11) becomes smaller than $1/9\,\beta^2$. In this case, the constrained tax rate will always be larger than the upper limit for t_A as defined by equation (7).

Considering the upper limit and the constraint given by (11), the equilibrium tax rate of country A, $t_A^{\ E}$, is given by:

$$t_A^{\ E} = \min\left(\beta; \frac{4}{3}\beta - \left(\frac{16}{9}\beta^2 - \frac{8}{3}\beta(1-\pi_B) \right)^{0.5} \right). \tag{12}$$

For the equilibrium tax rates defined by (12), the multinational firm always locates the production facility in country A and shifts profits into the low tax country which will levy a tax rate exactly half of that levied in its home country.

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[2] A second solution to equation (10) is given by $t_A^{\ C} = 4/3\,\beta + \left(16/9\,\beta^2 - 8/3\,\beta(1-\pi_B)\right)^{0.5}$. Since this implies tax rates above the upper limit defined by t_A, however, we can ignore this solution.

3. Comparative statics

3.1. Equilibrium tax rates

It is the central question of the analysis to investigate the effect of increased profit shifting on equilibrium tax rates. We therefore carry out a comparative static analysis where the cost parameter β is varied. Since t_B is determined by t_A^E, we only have to analyse the effect of a change in β on the tax rate set by country A.

For the upper limit, t_A, we simply get:

$$\frac{dt_A}{d\beta} > 0 \qquad (13)$$

from equation (7). As we have already argued above, the lower β, the higher the elasticity with which the tax base reacts to changes in tax rates. It is therefore quite intuitive that the upper limit for t_A increases when profit shifting becomes more expensive.[3]

Differentiating equation (11) with respect to the cost parameter β, we get:

$$\frac{dt_A^C}{d\beta} = \frac{4}{3} - \frac{\frac{16}{9}\beta - \frac{4}{3}(1-\pi_B)}{\left(\frac{16}{9}\beta^2 - \frac{8}{3}\beta(1-\pi_B)\right)^{0.5}}. \qquad (14)$$

As shown in the Appendix, the sign of equation (14) is negative. Hence, for those cases in which the constraint is binding, equilibrium tax rates are decreasing. For $\beta \to \infty$, we get that t_A^C converges towards $1-\pi_B$ which is equal to the tax rate levied in the case without profit shifting.

The intuition behind this result is that it becomes less attractive for country B to compete for the location of the production facility, the lower β. For given tax rates, a decrease in β will increase profit shifting. This decreases the total tax payments

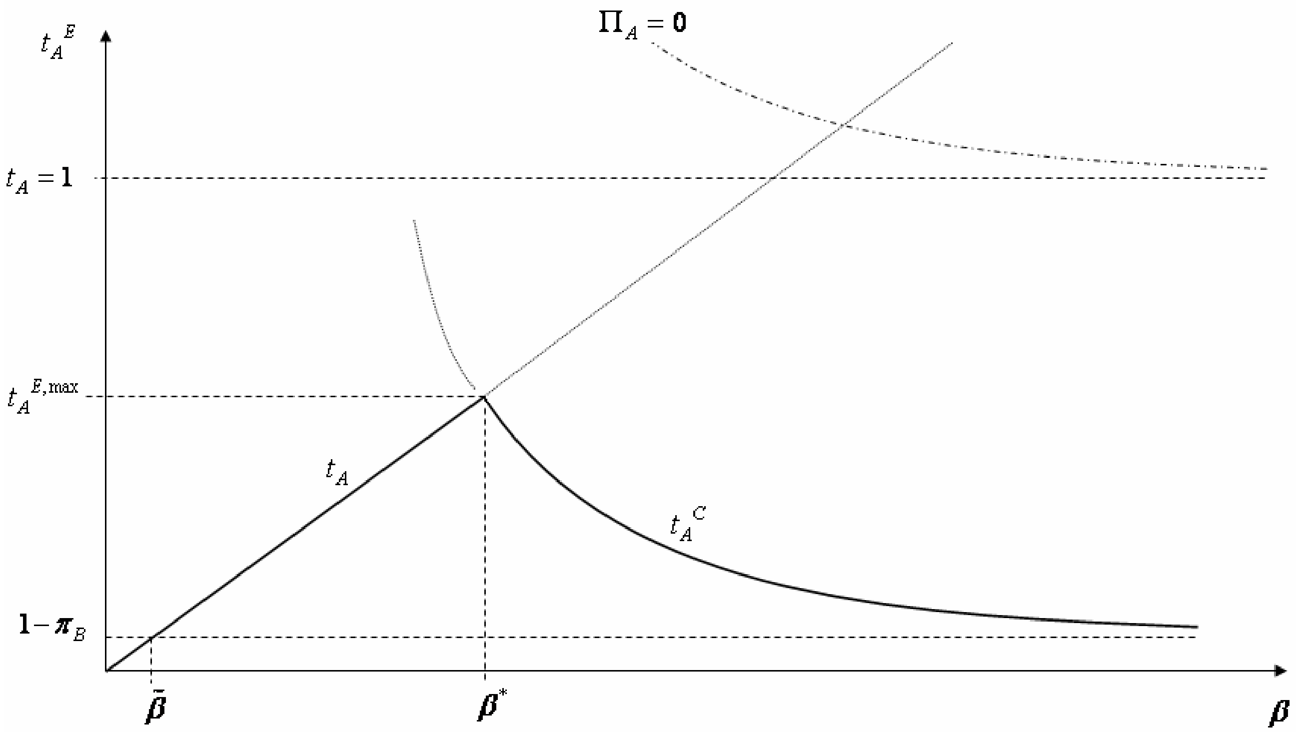
[3] Note that for $\beta > 4\beta - (16\beta^2 - 8\beta)^{0.5}$, the sign of equation (13) has to turn around in order to satisfy the condition of positive after-tax profits of the multinational firm. Since t_A^E is effectively constrained by t_A^C for large values of β, we ignore this possibility in our algebraic analysis.

the multinational firm has to pay when it locates in country A and thus makes this location more attractive. Country A, in turn, will explore this increased attractiveness by increasing its tax rate. For any given tax rate of country B, this effect will further increase the fraction of profits shifted into that country. The fraction of profits shifted and hence tax revenue of country B from profit shifting will increase more than linear with a decrease in β. The higher the revenues from profit shifting, however, the less attractive it becomes for country B to follow the alternative strategy to attract the multinationals production facility directly.

Figure 1 illustrates the dependency between the equilibrium tax rate chosen by country A and the cost parameter β.[4] As long as the costs for profit shifting are rather small, t_A^E is given by β and increasing the costs will increase equilibrium tax rates as well.

Figure 1

Equilibrium tax rates



[4] Equilibrium tax rates for the low tax country are not presented. They follow, however, those of the high tax country.

For $\beta > \beta^*$, the constraint becomes effective and equilibrium tax rates decrease when profit shifting costs are further increased. The maximum tax rate levied by country A can be found at β^* where it holds that $\beta = {}^4\!/_3\,\beta - \left({}^{16}\!/_9\,\beta^2 - {}^8\!/_3\,\beta(1-\pi_B)\right)^{0.5}$. As can be seen, the location of β^* and therewith the maximal tax rate levied, $t_A^{E,\max}$, depends on $1-\pi_B$. The higher the tax rate chosen in the absence of profit shifting, the higher β^*.[5] For prohibitive large values of β, the equilibrium tax rate of country A converges to that chosen in the case without profit shifting, $t_A^{\,E} = 1-\pi_B$. Compared to the case without profit shifting, equilibrium tax rates will be higher as long as it holds that β is larger than the critical value $\tilde{\beta} = 1-\pi_B$. This leads us to:

Proposition 1: (a) *If the reciprocal of the tax-base change caused by an adjustment in tax rates (under profit shifting) is higher than the tax rate chosen in the absence of any profit shifting, then introducing profit shifting will lead the high tax country to choose a higher equilibrium tax rate. (b) Under profit shifting, also the less productive country will levy a positive tax rate on profits.*

3.2. Tax revenue

Optimal level of profits shifted

Even though we have calculated equilibrium tax rates, a clear statement about tax revenue can not be made. In order to do so, we have to analyse how effective taxes paid by the multinational and its distribution among countries are influenced by a change in profit shifting costs. In a first step, we analyse the effect of β on the fraction of profits shifted. Again, we have to distinguish between two different tax regimes:

If it holds that $\beta \le \beta^*$, such that $t_A^{\,E} = t_A = \beta$, using (5) in (3), we get that the optimal fraction of profits shifted from the high tax to the low tax country is equal to one half. Hence, a variation of the cost parameter has no effect on profit shifting. For $\beta > \beta^*$, however, α is a function of β. Differentiating equation (3) with respect to the cost parameter, we get:

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[5] For $1-\pi_B$ close to one, the constrained tax rate may violate the condition of non-negative after-tax profits for the multinational firm. In such a situation, β^* is given by $\beta = 4\beta - \left(16\beta^2 - 8\beta\right)^{0.5}$.

$$\frac{d\alpha}{d\beta} = \frac{dt_A{}^C}{d\beta} \bigg/ 2\beta - \frac{t_A{}^C}{2\beta^2} < 0 \tag{15}$$

which is obviously negative from (14). Accordingly, it holds that $\alpha \leq 1/2$ for any given value of β.

Revenue of the high tax country

In a next step, we analyse how a change in the cost parameter affects revenue of the two countries. Differentiating equation (6) and using (15), we get for the high tax country A:

$$\frac{dR_A}{d\beta} = \begin{cases} 1/2 & if \quad \beta \leq \beta^* \\ \left(1 - \alpha - \frac{t_A{}^C}{2\beta}\right)\frac{dt_A{}^C}{d\beta} + 2\left(\frac{t_A{}^C}{2\beta}\right)^2 & if \quad \beta > \beta^* \end{cases} \tag{16}$$

For $\beta \leq \beta^*$, this expression is clearly positive. For $\beta > \beta^*$, we have two opposite effects: On the one hand, increasing β has a negative effect on the tax rate with which profits are taxed in country A. On the other hand, the tax base of country A increases with β. As shown in the Appendix, the latter effect will always dominate. Accordingly, tax revenue increases with the costs of profit shifting. Since $t_A{}^C$ converges towards $1-\pi_B$ and α converges towards zero for $\beta \to \infty$, revenue of the high tax country converges towards $1-\pi_B$.This leads us to:

Proposition 2: *(a) Tax revenue of the high tax country increases with the costs of profit shifting. (b) Tax revenues are lower than that in the case without profit shifting.*

Revenue of the low tax country

For the tax revenue of country B, differentiation of equation (4) yields:

$$\frac{dR_B}{d\beta} = \begin{cases} 1/4 & if \quad \beta \leq \beta^* \\ \frac{t_A}{2}\frac{d\alpha}{d\beta} + \frac{\alpha}{2}\frac{dt_A{}^C}{d\beta} & if \quad \beta > \beta^* \end{cases} \tag{17}$$

As shown by equation (17), for $\beta \leq \beta^*$, tax revenue of the low tax country is increasing with β. With $d\alpha/d\beta < 0$ and $dt_A{}^C/d\beta < 0$ from (14) and (15), however, higher costs of profit shifting diminish tax revenue once the constraint on tax rates comes into effect.

Proposition 3: *Tax revenue of the low tax country increases with the costs of profit shifting if these costs are low. For high* values *of* β *, higher costs lead to a decrease in tax revenue. Maximal revenue is given for medium costs of profit shifting.*

Total tax revenue

Total tax payments of the multinational firm can be obtained by adding up revenue of the two countries. Accordingly, the effect of a change in β on multinationals tax payments, $\hat{R} = R_A + R_B$, can be derived from equations (16) and (17). It is given by

$$\frac{d\hat{R}}{d\beta} = \begin{cases} 3/4 & \text{if} \quad \beta \leq \beta^* \\ \left(1-\alpha-\frac{t_A{}^C}{2\beta}\right)\frac{dt_A{}^C}{d\beta}+2\left(\frac{t_A{}^C}{2\beta}\right)^2+\frac{t_A}{2}\frac{d\alpha}{d\beta}+\frac{\alpha}{2}\frac{dt_A{}^C}{d\beta} & \text{if} \quad \beta > \beta^* \end{cases}.$$

Using (15), (5) and (3), this expression simplifies to:

$$\frac{d\hat{R}}{d\beta} = \begin{cases} 3/4 & \text{if} \quad \beta \leq \beta^* \\ (1-\alpha)\frac{dt_A{}^C}{d\beta}+\left(\frac{t_A{}^C}{2\beta}\right)^2 & \text{if} \quad \beta > \beta^* \end{cases} \tag{18}$$

For $\beta \leq \beta^*$, tax payments of the multinational firm are increasing with the costs of profit shifting. For $\beta > \beta^*$, however, $d\hat{R}/d\beta$ becomes negative (see the Appendix). Moreover, we know that for $\beta \to \infty$ revenue of the low tax country converges to zero while revenue of the high tax country converges to $1-\pi_B$. Taxes paid by the firm therefore exceed those in the case without profit shifting as long as it holds that $\beta > 4/3(1-\pi_B)$. This leads us to the main result of our analysis:

Proposition 4: *(a) For* $\beta > \beta^*$*, tax payments of the multinational firm are increasing with* β*. Tax payments are maximal for* $\beta = \beta^*$*. (b) For* $\beta > 4/3(1-\pi_B)$*, taxes paid by the multinational firm under profit shifting are higher than those in the case without profit shifting.*

It is the combination of two effects that leads to the result of increased tax payments for $\beta > \beta^*$. First of all, think of a situation where the low tax country levies a zero tax rate. As we have already noted above, increased profit shifting decreases the effective tax rate of the multinational when locating in country A. Without fear of losing the production plant to the low tax country, country A will then increase its tax rate up to the point where the effective tax payments (plus the costs of profit shifting) of the firm equal those in the case without profit shifting. The burden of the firm will be the same as without profit shifting. In fact, however, under profit shifting, it is optimal for the low tax country to set a positive tax rate as well. This positive tax rate increases the burden levied on the multinational firm even further above the level it has to cope with in the situation where there is no profit shifting at all.

Our analysis therefore shows that the strategic choice of tax rates by the two competing countries under profit shifting leads to a situation in which the taxes paid by the multinational generally exceed those in the case without profit shifting. This is due to the fact that competition for the production plant becomes less severe in the case of profit shifting. It allows both countries to increase its tax rates without affecting the location decision of the firm. Only for those cases in which the tax base reacts very sensitive to changes in the tax rate, i.e. profit shifting is rather inexpensive, competition for shifted profits dominates this locational effect and total taxes paid by the firm decrease when compared to the case without profit shifting.

In this respect, it has to be noted however, that after-tax profits of the firm will be lower than without profit shifting even in situations in which it holds that $\beta \leq 4/3(1-\pi_B)$. This is the case since the multinational has to bear the full costs of profit shifting, $\theta(\alpha,\beta)$, as well. For $\beta \leq \beta^*$, it holds that $\theta = 1/8\beta$. Considering these costs, the critical value for β, for which the multinational is better off compared to the case without shifting, further decreases. It is given by $\beta \leq 8/7(1-\pi_B)$.

4. Discussion

The simple model presented here has shown that profit shifting will not lead to a race to the bottom in corporate tax rates in most cases. Effectively, the strategic choice of tax rates by competing countries may lead to higher tax payments for multinational firms even though they follow a tax-minimizing strategy. Whether total tax payments of the multinational firm increase or decrease compared to the case without profit shifting does crucially depend on the elasticity with which taxable profits respond to changes in corporate tax rates. As stated by Proposition 4, the smaller the tax rate levied in the case without profit shifting -the smaller $(1-\pi_B)$-, the more elastic taxable profits have to respond to tax rate differentials in order to decrease the tax burden of the multinational firm. The probability that profit shifting harms the multinational firm is therefore larger the more equal the two competing countries.[6] Compared to Stöwhase (2005), these clear-cut results emerge from the discrete nature of the location decision. Moreover, as the present analysis shows, the low tax country will generally prefer medium costs of profit shifting for which revenue is maximal. This is in sharp contrast to the general argument that the low tax country will always favour more profit shifting (see e.g. Peralta et al., 2006). If the costs of profit shifting are assumed to be dependent on both countries monitoring policies and the high tax country is rather loose in monitoring profit shifting for some reasons, this would imply that the low tax country may gain by a stricter enforcement policy.

Clearly, our results depend on a number of assumptions and the model used is rather simple. Particularly, in order to calculate equilibrium tax rates we have to assume a specific type of profit shifting function. As can be shown, the general effects derived for this specific function, however, work very similar for other specifications of the cost function as long as they ensure an interior solution for the fraction of profits shifted.[7] Allowing for additional positive effects from attracting the production facility, e.g. increased demand for labour in the case of regional unemployment or lower consumer prices, may change our results to some degree. Nevertheless, as long as these additional effects do not result in subsidy competition between the two countries, our general results prevail. When there is no profit shifting, increased competition for the production plant will shift down the tax rate levied by country A. For the case where there is profit shifting, only the constrained tax rate is affected by increased competition: β^* as well as the maximal tax payment of the firm will decrease. The critical value of β, however, for which tax payments of the multinational firm increase, will shrink with the tax rate levied in the case without

[6] To give an illustrative example: For $(1-\pi_B)=0.07$, our model predicts that the multinational firm is harmed unless the semi-elasticity of the tax base with respect to the tax rate differential is equal or larger than 25., i.e. a one percentage point increase in the tax rate differential has to enlarge α by more than one quarter. For $(1-\pi_B)=0.21$, the corresponding semi-elasticity decreases to approximately 8.

[7] This does also include cases in which more than one half of profits are shifted such that revenue of the low tax country exceeds those of the high tax country.

profit shifting. Consequently, the effect of increased tax payments will strengthen with such an extension of the basic model.[8]

To facilitate understanding of the basic effects concerning the interaction between competition for real investment and taxable profits, we employed a very simple model. As our discussion shows, however, results can be assumed to be valid in even more complex environments. In a way, it can be seen therefore as some kind of workhorse model for future research.

5. Conclusion

This paper explores the effect of profit shifting on the tax setting game between two revenue maximizing countries that compete for the location of a single production plant owned by a multinational firm. For the simple model used here, it can be shown that the strategic choice of tax rates will lead to a race to the top in many cases when profit shifting becomes less expensive for firms. This result stems from the fact that on the one hand profit shifting decreases the costs of capital in the high tax country; while on the other hand, the low tax country will levy a positive tax rate on shifted profits in equilibrium. Only if profits can be shifted rather inexpensively across countries, increased mobility of the tax base will result in a race to the bottom in corporate tax rates.

While profit shifting always leads to a redistribution of tax revenue from the high tax country to the low tax country, total tax payments of the multinational firm exceed those in the case without profit shifting in most cases. Total tax payments of the firm and revenue of the low tax country are maximal for medium costs of profit shifting.

These results have some clear policy implications not only for low tax countries but also for multinational firms. According to our results, low tax countries might find it optimal to implement at least some regulations that make it more difficult for multinational firms to shift profits into the country. This will lead to a situation in which competition in tax rates is less severe such that revenue for both countries

[8] Equivalently, this result will turn around in those cases in which the location of the production plant brings about some negative effects for the host country such as environmental pollution.

increases. Even though multinational firms will generally prefer zero costs of profit shifting, they may opt for more severe constraints once these costs exceed a given level. Considering the case where profit shifting costs are endogenously chosen by the two competing countries would be a novel extension of the present model

Clearly, more theoretical work is needed in order to analyse how the basic effects derived here work in more complex models of tax competition. Moreover, empirical work is needed that analyses the effect of profit shifting regulations on equilibrium tax rates. This should possibly include information about the tax-sensitivity of taxable profits. Future research should concentrate on this point.

Appendix

A.1. Determining the sign of equation (14)

For $dt_A^C/d\beta$ to be negative, it has to hold that:

$$\frac{4}{3}\left[\frac{16}{9}\beta^2-\frac{8}{3}\beta(1-\pi_B)\right]^{0.5}<\frac{16}{9}\beta-\frac{4}{3}(1-\pi_B)\,. \qquad \text{(A.1)}$$

Since we have $\beta \geq 3/2(1-\pi_B)$ for the constrained tax rate, both sides of equation (A.1) are positive. We can equivalently write:

$$\frac{16}{9}\left[\frac{16}{9}\beta^2-\frac{8}{3}\beta(1-\pi_B)\right]<\frac{256}{81}\beta^2-\frac{128}{27}\beta(1-\pi_B)+\frac{16}{9}(1-\pi_B)^2\,. \qquad \text{(A.2)}$$

This expression simplifies to:

$$0\leq\frac{16}{9}(1-\pi_B)^2 \qquad \text{(A.3)}$$

It follows from (A.3) that $dt_A^C/d\beta$ is negative.

A.2. Determining the sign of equation (16)

Substituting for α , t_A^C and $dt_A^C/d\beta$ in equation (16) and simplifying yields:

$$\frac{\left(\frac{32}{81}\right)^{0.5}\beta-\left(\frac{2}{9}\right)^{0.5}(1-\pi_B)-\frac{4}{9}\left[2\beta^2-3\beta(1-\pi_B)\right]^{0.5}}{\left[2\beta^2-3\beta(1-\pi_B)\right]^{0.5}}. \tag{A.4}$$

With the denominator being positive, the numerator has to be positive as well to have $dR_A/d\beta>0$. Rearranging gives:

$$\beta-\frac{3}{4}(1-\pi_B)>\left(\frac{1}{2}\right)^{0.5}\left[2\beta^2-3\beta(1-\pi_B)\right]^{0.5} \tag{A.5}$$

With both sides of the equation being positive, we can equivalently write:

$$\beta^2-\frac{3}{2}\beta(1-\pi_B)+\frac{9}{16}(1-\pi_B)^2>\beta^2-\frac{3}{2}\beta(1-\pi_B) \tag{A.6}$$

This expression simplifies to:

$$\frac{16}{9}(1-\pi_B)^2\geq 0 \tag{A.7}$$

It follows from (A.7) that $dR_A/d\beta$ is positive for $\beta>\beta^*$.

A.3. Determining the sign of equation (18)

Substituting for α, $t_A^{\ C}$ and $dt_A^{\ C}/d\beta$ in equation (18) and simplifying yields:

$$\frac{\left(\frac{2}{9}\right)^{0.5}\beta^2(1-\pi_B)+\frac{2}{3}\beta(1-\pi_B)\gamma^{0.5}+\frac{2}{9}\gamma^{1.5}-\left(\frac{32}{81}\right)^{0.5}\beta^3}{\left[2\beta^4-3\beta^3(1-\pi_B)\right]^{0.5}} \tag{A.8}$$

with $\gamma=2\beta^2-3\beta(1-\pi_B)$

With the denominator being positive, the numerator has to be negative in this case to have $d\hat{R}/d\beta<0$. Rearranging gives:

$$\frac{4}{9}\beta\gamma^{0.5}<\left(\frac{32}{81}\right)^{0.5}\beta^2-\left(\frac{2}{9}\right)^{0.5}\beta(1-\pi_B). \tag{A.9}$$

Equivalently, it has to hold that:

$$\frac{32}{81}\beta^4 - \frac{48}{81}\beta^3(1-\pi_B) < \frac{32}{81}\beta^4 - 2\left(\frac{32}{81}\right)^{0.5}\left(\frac{2}{9}\right)^{0.5}\beta^3(1-\pi_B) + \frac{2}{9}\beta^2(1-\pi_B)^2 \tag{A.10}$$

With $48/81 = 2(32/81)^{0.5}(2/9)^{0.5}$, this simplifies to:

$$0 \leq \frac{2}{9}(1-\pi_B)^2 \tag{A.11}$$

It follows from (A.11) that $d\hat{R}/d\beta$ is negative for $\beta > \beta^*$.

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