Corporate taxation, profit shifting, and the efficiency of public input provision [1]

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[1]This paper was presented at the Norwegian-German Seminar on Public Economics in Munich and at the University of Göttingen. We thank seminar participants, in particular Thomas Dickescheid, Wolfram F. Richter and Agnar Sandmo, for their critical and constructive remarks. We also wish to thank two referees of this journal for their detailed and helpful comments, and Kare P. Hagen for a stimulating discussion which provided the starting point for this research.

Abstract:

In this paper we analyze the implications for the national provision of public inputs when profit shifting is possible, albeit costly, for internationally integrated firms. In this case a high level of public infrastructure will attract real investment, but the firm can at least partly avoid to pay correspondingly high corporate taxes. In contrast to much of the recent literature on capital tax competition and public infrastructure provision we thus find that public inputs will be unambiguously underprovided when the corporate tax falls only on pure profits and international taxation follows the source principle. Extensions of the basic model cover the case of distortive capital taxes and alternative international tax regimes.

Zusammenfassung:

Der Aufsatz beschäftigt sich mit der Frage, ob öffentliche Inputs effizient bereitgestellt werden, wenn internationale Gewinnverschiebungen innerhalb verbundener Firmen möglich sind. Unter diesen Bedingungen können Unternehmen in Ländern mit einem hohen Niveau öffentlicher Zwischenprodukte investieren, durch Gewinnverschiebungen aber eine entsprechend hohe Steuerzahlung in diesem Land vermeiden. Als optimale Reaktion einer kleinen offenen Volkswirtschaft ergibt sich eine eindeutige Unterbereitstellung öffentlicher Inputs im Gleichgewicht, wenn der ffentliche Produktionsfaktor durch eine Quellensteuer auf die Reingewinne eines (repräsentativen) Unternehmens finanziert wird. Die Robustheit dieses Ergebnisses wird für den Fall einer verzerrenden Kapitalsteuer und für alternative internationale Besteuerungsprinzipien untersucht.

JEL classification: H25, H54, H87

1 Introduction

Most of the early work on capital tax competition has been concerned with the question of whether tax rates are set too low in the competitive tax equilibrium in order to finance an efficient level of public *consumption* goods. An early exception was the influential contribution by Zodrow and Mieszkowski (1986) which considered the provision of both public consumption goods and public inputs. Rather surprisingly, the outcome of their investigation was that there were no qualitative differences between the two analyses, and underprovision was equally likely in both cases. This initial finding probably contributed to the relative lack of attention paid to the distinction between public consumption goods and public inputs in the subsequent literature on capital tax competition.

Recently, however, a substantial number of contributions have (re-) addressed the issue of whether public *inputs* may be efficiently provided in multijurisdictional models of non-cooperative capital taxation; see Richter (1994), Fuest (1995), Pfähler and Lorz (1995), Richter and Wellisch (1996), Keen and Marchand (1997), Sinn (1997), Bayindir-Upmann (1998), Tausch (1998). While these studies differ in the model used, and in the precise results obtained, a common finding is that the difference between public consumption goods and public inputs is, in fact, an important one. While public consumption goods are always undersupplied in these types of models the same is not true, in general, for the provision of public inputs.[1] At the very least, what can be said is that the undersupply of public inputs is less severe than the undersupply of public consumption goods. The reason for this is that public inputs, in contrast to public consumption goods, either reduce the private costs of production or increase the marginal productivity of capital. Hence, the 'net fiscal burden' of a given capital tax is lower, from the perspective of an internationally mobile investor, when the revenue goes to finance a public input. From the perspective of static welfare maximization, it then follows that too much of a given government budget is spent on public inputs in the non-cooperative equilibrium and too little on public consumption (Keen and Marchand, 1997).

From a policy perspective, the focus on the efficiency of public input provision is

[1] It has also been pointed out that the seemingly conflicting earlier result by Zodrow and Mieszkowski (1986) is derived under a very restrictive assumption which, in essence, already implies their final result (see Noiset, 1995; Sinn, 1997; Matsumoto, 1998).

a very appropriate one in conjunction with the taxation of capital. Revenues from capital taxation, i.e. corporation taxes and personal income taxes levied on dividend and interest income, generally represent only a relatively small share of total tax revenues in OECD countries. Arguably, capital taxes thus play a less important role for the overall financing of public goods and the maintenance of the welfare system than the value-added tax or the taxation of wage income (including social security contributions). On the other hand, there is empirical evidence that public infrastructure plays a significant role for macroeconomic growth and employment.[2] To those who are concerned primarily with the long-run growth consequences of fiscal competition, the finding that non-cooperative capital taxation need not generally lead to an undersupply of public inputs seems to be a comforting one.

However, virtually all of the existing literature on capital tax competition and public input provision models the mobility of the capital tax base in one of the following two ways: either the marginal investment decision is distorted by source-based taxes on the capital installed in a given country (see Zodrow and Mieszkowski (1986), Keen and Marchand (1997), or Sinn (1997)), or entire firms can be relocated internationally (see Richter (1994) or Richter and Wellisch (1996)). The difference between these two approaches is that taxes on pure profits are lump-sum instruments in the first scenario, but not in the second. The common feature of the two types of models is, however, that an investor (a firm) trying to benefit from the provision of public infrastructure in a given country cannot avoid being simultaneously taxed in this same jurisdiction.

While this seems a reasonable assumption at first sight, the growing importance of foreign direct investment through multinational corporations (MNCs) has increased the relevance of a new type of capital tax base mobility. Profits are shifted "in the books" (albeit, presumably at some cost), without any real decisions being affected by this operation. In this setting it is possible for a firm to have the best of both worlds: to benefit from the favourable public infrastructure in one jurisdiction by placing its physical investment there, but avoid paying the correspondingly high taxes by shifting its profits to a low-tax, low-infrastructure jurisdiction in which it

[2]The early and influential work by Aschauer (1989a, 1989b) estimates, for example, that for a standard macroeconomic production function of the Cobb-Douglas type, with capital, labour and public infrastructure as inputs, the production elasticity of the public input factor is in the range of 0.3. See Richter, Seitz and Wiegard (1996) for a theoretical and empirical overview of the recent literature.

also maintains a physical presence.

There is substantial evidence for tax-motivated transfer pricing.[3] Grubert and Mutti (1991) and Hines and Rice (1994) analyze the aggregate reported profitabilities of U.S. affiliates in various foreign locations in 1982. Both studies find strong indirect evidence for transfer pricing in that high taxes reduce the reported profitability of local operations. Harris et al. (1993) report that the U.S. tax liabilities of American firms with affiliates in tax havens are significantly lower than those of comparable domestic firms over the 1984-1988 period. More recently, Collins, Kemsley and Lang (1998) study a pooled sample of U.S. multinationals and find that 'normalized' reported foreign profitability exceeds U.S. profitability among firms facing foreign tax rates below the U.S. rates. In Europe, Weichenrieder (1996) presents evidence that German firms have taken advantage of the low Irish tax rate in the manufacturing sector by shifting the returns to financial assets ("passive income") to its subsidiaries in Ireland. Subsequent German tax legislation that restricted the ratio of passive to active income earned in a foreign country, led to a shift from financial to real investment in Ireland so that the new constraint could be relaxed.

The empirical evidence in support of profit shifting suggests that multinationals can benefit from local public infrastructure without contributing their 'fair' share to the provision of such goods. Against this background, we set up a model of corporate taxation and profit shifting to analyze the efficiency of public input provision in this setting. Section 2 presents our benchmark model where corporate taxes fall only on pure profits and a pure source principle applies to international investments. In this setting, it is shown that public inputs will be unambiguously underprovided in the presence of profit shifting. Section 3 extends the analysis to account for capital taxes that distort the firm's investment decision. In this case the resulting underprovision is no longer unambiguous. Section 4 goes on to consider alternative international tax regimes, in particular an international tax deduction method. Section 5 concludes the discussion.

[3]For a survey of this literature, see Hines (1999).

2 The benchmark model

We consider here a representative firm in a small country whose tax policies do not affect the world interest rate. The production function of the firm is given by $f(k, g)$, where k is private capital and g is a public input. The marginal productivity of both k and g is positive but diminishing, and the Inada conditions hold, i.e., $f_k(k = 0) \to \infty$ and $f_g(g = 0) \to \infty$. In addition we assume that the production function exhibits decreasing returns to scale in k and g together, due to the existence of a firm-specific fixed factor which can be interpreted as 'entrepreneurial services'. This ensures that the firm will always make positive profits, even if it is fully charged for the value added by the public input.

The representative firm in our model is a multinational corporation (MNC) which has its headquarters in the small country and fully owns a subsidiary abroad. The MNC is assumed to maximize its worldwide net-of-tax profits. This is the conventional assumption in the tax literature, which implies that aggregate tax savings are the overriding concern for the MNC when it tries to influence the division of its total gross profits across different jurisdictions.[4]

If foreign subsidiaries of multinationals are separate and independent entities, they will be subject to corporate taxation in the source country of the investment. In addition, the host country levies dividend taxes or withholding taxes when profits are repatriated to the home country of the parent company. Existing double taxation agreements either stipulate that the MNC's home country exempts these capital incomes from tax, or that it grants a (limited) tax credit. If the exemption method is applied, then the taxation of corporate profits follows a pure source principle. Many authors characterize the worldwide practice of corporate taxation as corresponding quite closely to the source principle; see Tanzi and Bovenberg (1990) and Sørensen (1995). This scenario underlies the analysis in the present section. Alternative international tax regimes are discussed in more detail in section 4.

Furthermore, we initially assume a 'neutral' corporation tax which falls only on pure profits and does not distort the marginal investment decision. Such a tax can

[4] A different approach is taken by Elitzur and Mintz (1996), where the profits made by the foreign subsidiary determine the remuneration of its manager. In this setting there is a trade-off for the MNC between the minimization of its worldwide tax payment and the incentives given to the subsidiary's managing partner.

be implemented either by the immediate expensing of all investment expenditures (cash-flow tax), or through the deduction of all interest costs, including the opportunity costs of internal financing, from the corporate tax base.[5] The assumption of pure profit taxation will be relaxed in the following section.

We focus on the MNC's investment decision in the home country while its real foreign operations remain exogenous to the analysis. In addition to choosing the domestic level of investment, the controlling interest in two independent jurisdictions enables the MNC to affect its overall tax payment through transfer pricing. Transfer pricing is modelled in the simplest possible way.[6] We assume that the parent located in the home country provides one unit of an overhead service to its subsidiary abroad. The true (arm's-length) price of this service equals unity, but this price cannot be directly observed by tax authorities. Hence, the transfer price p becomes an additional choice variable for the firm which may either overinvoice ($p > 1$) or underinvoice ($p < 1$) in order to reduce aggregate tax payments. To balance trade within the integrated firm in real terms, the foreign subsidiary delivers one unit of output, valued at the 'true' price of unity, to its parent in the home country in order to pay for the overhead services received.

Transfer pricing involves, however, resource costs to the integrated firm, which are assumed to be a convex function of the difference between the declared and the true price of the overhead service. This assumption is standard in the literature on both tax evasion and transfer pricing. It can be justified either by an increased probability of detection, see Kant (1988), or by additional efforts that need to be taken in order to conceal the transfer pricing activity from tax authorities, see Huber (1997). In the latter case, the transaction costs incurred by the firm represent a pure waste of resources and this is the scenario that underlies the present analysis. The concealment (transaction) cost function is denoted by $\theta(p)$ and possesses the following standard properties:

$$\theta(1) = \theta'(1) = 0, \quad sign(\theta') = sign\,(p-1), \quad \theta''(p) > 0. \tag{1}$$

[5] See Cnossen (1996) for a recent overview of these different variants of pure profit taxes. Existing corporation taxes, which permit only a deduction of the interest expenditures actually incurred, also turn into taxes on pure profits when firms have sufficient financial flexibility to finance new investments exclusively from external sources; see Sinn (1991) for a detailed discussion.

[6] In Haufler and Schjelderup (2000), the same model element is used to analyze the implications of profit shifting within multinational corporations on the optimal structure of corporate tax systems, i.e. the mix of tax rate and tax base.

With these specifications the global net profits of the MNC can be written as

$$\Pi^N = (1-t)\left[f(k,g) + (p-1) - r\,k\right] + (1-t^*)\left[f^*(\bar{k}^*, g^*) - (p-1) - r\,\bar{k}^*\right] - \theta\,(p),$$

where foreign variables are denoted by an asterisk (*). Note also that we have assumed that $\theta(p)$ is not tax-deductible. This implies that concealment costs (just like bribes) are not allowed to enter the tax books of firms.[7] Finally, the firm's foreign investment $\bar{k}^*$ is fixed in our analysis. Hence we can simply write total net profits of the MNC as

$$\Pi^N = (1-t)\left[f(k,g) + (p-1) - r\,k\right] + (1-t^*)\left[\bar{R} - (p-1)\right] - \theta\,(p), \qquad (2)$$

where $\bar{R} \equiv f^*(\bar{k}^*, g^*) - r\bar{k}^*$ gives the 'true' gross profits from the MNCs foreign operations.

Differentiating (2) with respect to the firm's choice parameters k and p gives:

$$f_k(k,g) = r, \qquad (3)$$

$$\theta'(p) = t^* - t. \qquad (4)$$

These first-order conditions are easily interpreted. Since we have modelled a pure profit tax, the firm's optimal investment decision (3) is not distorted by the tax. Hence, there is no 'underinvestment' in the home country in our model due to source-based capital taxation. Equation (4) equates the tax savings from transfer pricing to the marginal transaction costs incurred. The overhead service will be overinvoiced if $t < t^*$ and underinvoiced if $t > t^*$; in each case profits are shifted from the high-tax to the low-tax country of the multinational's operations.

Note that in our simple framework the MNC's maximization problem dichotomizes into independent investment and transfer pricing decisions. This is due to the joint assumptions that the concealment costs θ are the only costs associated with profit shifting, and that these costs depend only on the absolute difference between the true and the declared price of the overhead service provided by the parent. Under more general specifications of $\theta(p)$, the investment decision may also be distorted by transfer pricing.[8]

[7] It can be argued that it is more realistic to treat at least some concealment costs as tax-deductible (e.g. the time spent by the firm's executives to conceal profit shifting activities). Note, however, that making these costs tax-deductible will only strengthen the incentive for transfer pricing, since the firm then bears only a fraction of its gross concealment costs.

[8] See Haufler and Schjelderup (2000, sec. 5) for a more detailed discussion.

The government in the small (home) country optimally sets the corporate profit tax rate t and chooses the level of public inputs g. The two instruments are linked by the government budget constraint

$$t\ [f(k,g) + (p-1) - r\ k] \equiv t\ T = g, \tag{5}$$

where the home government's tax base (i.e., declared profits) has been denoted by T and the marginal rate of transformation between the public input and the private consumption good in the economy is fixed at unity.[9]

In our setting of firm taxation and public input provision the only effect of government policy on the (representative) consumer is through the value of the firm's net profits, which are transferred to the consumer by assumption. Hence utility maximization is equivalent in our model to the maximization of the firm's net profits, or to the maximization of the net rents that are derived from the provision of public inputs. Maximizing (2) subject to the government budget constraint (5) and incorporating functional dependencies, the Lagrangian is given by[10]

$$\begin{aligned} \mathcal{L} &= (1-t)\left\{f\ (k,g) + [p(t)-1] - r\ k\right\} \\ &+ (1-t^*)\left\{\bar{R} - [p(t)-1]\right\} - \theta\ (p) + \lambda\left\{t\ T\ [p(t),g] - g\right\} \end{aligned}$$

The first-order condition with respect to the public input g is, using (5)

$$f_g = \frac{\lambda}{1 + t(\lambda - 1)}\ . \tag{6}$$

With pure lump-sum taxation the shadow price of public funds must equal the price of private consumption, which has been normalized to unity. Hence if lump-sum taxation were possible $\lambda = 1$ would have to hold. It is then clear from equation (6) that $f_g = 1$ describes the first-best level of public input provision in this model. In the following the results from our profit shifting model will be contrasted with this first-best outcome.

[9] In principle, in our model it would be possible for declared profits in one country to be negative due to transfer pricing. We rule out this possibility throughout the analysis by assuming that the transaction cost schedule $\theta(p)$ [see eq. (1)] is sufficiently steep to prevent firms from shifting all profits out of the high-tax country.

[10] Our analysis treats both t and g as government choice variables, and incorporates budget balance as an explicit constraint. This approach turns out to be analytically simpler than the alternative of substituting the budget balance equation directly into the objective function. The latter approach is followed in the appendix, and it is shown there that it leads to identical results.

Using the envelope theorem, the first-order condition for the corporate tax rate t is

$$\lambda = T \Big/ \left(T + t \, \frac{\partial p}{\partial t} \right) = T \Big/ \left(T - \frac{t}{\theta''} \right) > 1, \tag{7}$$

where in the second step we have implicitly differentiated (4) to determine $\partial p / \partial t$. This result shows that in the present model with profit shifting, even a corporation tax that falls only on pure profits will not be a lump-sum instrument, and $\lambda > 1$ will obtain in the government optimum [note that $\theta'' > 0$ from (1)].

Using (6) in (7) and rearranging we obtain the final expression for the optimal combination of t and g:

$$f_g = 1 \Big/ \left[1 - \frac{(1-t)\, t}{T \, \theta'' \, (t, t^*)} \right] > 1. \tag{8}$$

Equation (8) demonstrates that public inputs are unambiguously underprovided in the setting assumed here, since the marginal productivity of the public input exceeds its pure resource cost of unity. The result that $f_g > 1$ is rigorously demonstrated in the appendix, which shows that $0 < t < 1$ must hold in the optimum, and hence the second term in the squared bracket is strictly positive.

It is clear from (8) that the degree of underprovision depends on how costly it is for the firm to conceal its transfer pricing activities. An increase in the convexity of the concealment cost function (i.e., an increase in θ'') reduces the underprovision of public inputs since the domestic tax base becomes less tax elastic. In general, the term $\theta''[p(t)]$ reflects that a rise in t will reduce the domestic profit tax base in the presence of international profit shifting and (in the same way as other distortive taxes do) increase the excess burden of taxation. Note in particular that this excess burden is obtained irrespective of whether the foreign tax rate t^* is higher or lower than the optimal domestic tax rate t, as long as both tax rates are non-negative. If $t > t^*$ in the home country's optimum, then the home government balances the extra benefits of public input provision against the marginal costs incurred by increased profit shifting out of the home country. In contrast, if $t < t^*$, then the extra costs of increased public input provision instead lie in a *reduced* level of profit shifting *into* the home country.

Note finally that the second-order cross-derivative f_{kg}, which has played an important role in previous analyses of capital taxation and public input provision, does

not appear at all in our benchmark analysis.[11] This is the joint effect of our assumptions that the mobile tax base is paper profits, rather than physical capital, and that the corporate tax falls only on pure profits. In this case the incentive for the firm to shift profits abroad depends only on the tax differential between the home and the foreign country; hence there is no 'public input effect' that tends to offset the effect of the higher tax and thus tends to keep the tax base in the home country. (Of course, the firm nevertheless benefits from the higher level of public infrastructure, and gross profits rise.) In the following section we will see that the cross-derivative f_{kg} re-enters the analysis when we introduce a corporate tax system that distorts real investment decisions.

3 Non-neutral capital taxation

In this section we consider a more general type of corporation tax, which will generally distort the firm's investment decision. Let α denote the share of the costs of capital that can be deducted from the tax base for tax purposes. Then the tax base in the small country is given by

$$\tilde{T} = f(k,g) + (p-1) - \alpha\, r\, k, \qquad 0 < \alpha < 1, \tag{9}$$

where $\alpha = 1$ corresponds to the benchmark case of investment-neutral corporate income taxation, as discussed in the previous section.

The firm's global net profits are obtained by subtracting tax payments under the the more general definition of the tax base from the gross profits earned. Hence

$$\begin{aligned} \tilde{\Pi}^N &= f(k,g) + (p-1) - r\, k - t\, \left[f(k,g) + (p-1) - \alpha\, r\, k\right] \\ &+ (1-t^*)\left[\bar{R} - (p-1)\right] - \theta\,(p), \end{aligned}$$

[11] In Zodrow and Mieszkowski (1986), for example, the underprovision result critically hinges on the *assumption* that the cross-derivative f_{kg} is sufficiently low. Their central equation (16) states (in our notation) that $1 - k\, f_{kg} > 0$. As has been emphasized by Noiset (1995), Sinn (1997, footnote 9) and Matsumoto (1998), this assumption already implies their final result that public inputs will be underprovided in equilibrium. For example, it is easily checked in their model that a production function of the type $f\,(k,g) = g\, \ln k$ implies $1 - k\, f_{kg} = 0$. In this case the effects of a higher capital tax rate are exactly offset by the higher productivity of capital through the rise in public infrastructure; hence public input provision will be efficient.

which yields, after rearranging

$$\tilde{\Pi}^N = (1-t)\,[f(k,g) + (p-1)] - r\,k\,(1-\alpha\,t) + (1-t^*)\left[\bar{R} - (p-1)\right] - \theta\,(p). \quad (10)$$

The firm's first-order condition for the choice of k is now given by

$$f_k = \frac{(1-\alpha\,t)\,r}{(1-t)}. \quad (11)$$

For $\alpha < 1$, equation (11) implies that $f_k > r$ in the firm's optimum so that the marginal productivity of domestic investment exceeds the opportunity cost of capital in the world market. At the same time, the firm's first-order condition for the transfer price p is unchanged from (4).

The government again maximizes the net rents from public input provision, subject to the financing constraint, but now has to incorporate the effects of t and g on the domestic capital stock. The new Lagrangian is

$$\begin{aligned}\tilde{\mathcal{L}} &= (1-t)\,\{f\,[k(g,t),g] + [p(t)-1]\} - r\,k(g,t)\,[1-\alpha\,t] \\ &+ (1-t^*)\left\{\bar{R} - [p(t)-1]\right\} - \theta\,[p(t)] \\ &+ \lambda\,(t\,\{f\,[k(g,t),g] + p(t) - 1 - \alpha\,r\,k(g,t)\} - g)\ .\end{aligned}$$

The first-order condition with respect to the public input g is, using the firm's optimal investment rule (11)

$$f_g = \left[1 - t\,\frac{\partial k}{\partial g}\,(f_k - \alpha\,r)\right]\,\frac{\lambda}{[1+t(\lambda-1)]}\ . \quad (12)$$

This corresponds to equation (6) in the previous section if and only if costs of capital are fully deductible ($\alpha = 1$). In this case the optimal capital stock is determined by $f_k = r$ so that the first bracketed term in (12) reduces to one for *any* functional relationship in production $\partial k/\partial g$. For $\alpha < 1$, however, the firm's first-order condition (11) implies $f_k - \alpha\,r > 0$. The first term in (12) will then be less than one when capital and the public input are complements in production ($\partial k/\partial g > 0$). This complementarity is usually assumed in the literature, and there is also empirical support for this specification.[12]

[12]Seitz (1994), for example, presents econometric evidence for complementarity between public and private capital in the West German manufacturing sector.

Similarly, we obtain the first-order condition for the corporate tax rate t, using the envelope theorem and the firm's optimality conditions (4) and (11). This yields

$$\lambda = 1 \Big/ \left(1 + \frac{t}{T}\left[\frac{\partial k}{\partial t}(f_k - \alpha\, r) - \frac{1}{\theta''}\right]\right) > 1. \tag{13}$$

From (13) we can immediately infer that $\lambda > 1$ in this analysis. We already know from our discussion of (12) that $f_k - \alpha r > 0$ for $\alpha < 1$. Furthermore, with imperfect deductibility of capital, implicit differentiation of (11) gives $\partial k/\partial t < 0$, since $f_{kk} < 0$. Hence the first term in the squared bracket in (13) is unambiguously negative. This, of course, represents the investment distortion caused by the capital tax for any $\alpha < 1$. In addition, the second term in the squared bracket is also unambiguously negative since $\theta'' > 0$ from (1). This term captures the additional excess burden caused by profit shifting, which has also been present in our benchmark analysis. The total excess burden is composed of both effects, yielding a shadow price of public funds λ that unambiguously exceeds unity.

Combining (12) and (13) gives the final optimality condition for the public input. We do not actually carry out this substitution because the resulting expression would be extremely complex. Instead, it is clear from our discussion so far that for $\alpha < 1$ the first term in (12) will be less than one if capital and the public input are complements in production, whereas the second term in (12) is unambiguously greater than one, since $\lambda > 1$ from (13). Hence in general, f_g can be greater or less than one in the optimum, indicating either an undersupply or an oversupply of public inputs. The possibility for an oversupply of public inputs will of course be greater, the larger is the complementarity term $\partial k/\partial g$.

The intuition for the ambiguous results obtained under a distortive capital tax is that, with complementarity between capital and the public input, raising g is a way to counteract the distortion in the capital market and thus to raise k back towards its efficient level. The welfare gains from this effect, which are absent under a pure profit tax, are traded off against the welfare losses caused by profit shifting that arise from the tax increase needed to finance the higher level of public inputs.

Note, on the other hand, that in general the excess burden of the corporate income tax is now larger as compared to our benchmark analysis, since the tax distorts the firm's investment decision in addition to its effect on profit shifting. Therefore, if the complementarity term is sufficiently weak, it is even possible that the undersupply of public inputs becomes more severe when the capital tax distorts the firm's

investment decision. This is simply due to the fact that, all other things being equal, the increased excess burden of a corporate income tax, with imperfect deductibility for the costs of capital, makes the supply of public inputs more expensive.

4 Alternative international tax regimes

In this section we relax the assumption that international taxation follows a pure source principle, where the residence country fully exempts foreign-earned capital income from tax. Instead, we analyze different forms of international tax credit schemes. We revert, however, to the assumption of our benchmark model that the corporation tax falls only on pure profits.

A complication with international tax credits arises from the fact that these credits do generally not cover the corporation taxes levied in the host country. Therefore, the integration of corporate and personal income taxation in the host country is relevant for the effective taxation of international profit income. Our discussion below is confined to the case where both countries operate a dual income tax with full imputation of corporate taxes.[13] Under this scheme, all capital income is taxed only once at a uniform rate (whereas labor income is taxed at different, and possibly progressive, rates) and the corporation tax does not constitute a final tax liability.

We initially consider the case where the home country grants a tax credit for dividend and withholding taxes paid abroad, but limits the credit to the amount of tax that would have been levied on the same profit income earned in the home country. Under this limited tax credit method, two possible cases must be distinguished. Firstly, if the domestic tax rate on repatriated dividends is higher than the foreign dividend tax rate, a full credit is given for the foreign taxes paid. In this case, the MNC is subject to the domestic tax rate on all its profits and it is immediately obvious that no incentive remains for international profit shifting. Secondly, if the foreign tax rate on dividends exceeds the domestic tax rate, the use of a limited tax credit means that repatriated profits are effectively exempt from dividend taxation

[13]This system of corporate taxation is used by the Nordic countries, and full imputation is followed by Finland and Norway. As noted by Cnossen (1996), the treatment of capital income taxation under the dual income tax strongly resembles its treatment under a comprehensive business income tax as proposed by the US Department of Treasury (1992).

in the home country. Thus, domestic and foreign profits are taxed at different rates, and we are back to our basic model of pure source taxation of profits.

A more interesting extension arises when foreign taxes paid are treated as business costs deductible against taxable income in the residence country (tax deduction method). In this case international investments are subject to double taxation since foreign profits are first taxed abroad and then the remaining income is subject to tax in the residence country. If the tax deduction scheme applies, the net profit equation of the MNC is

$$\Pi^N = (1-t)\left\{f(k,g) + (p-1) - rk + (1-t^*)\left[\bar{R} - (p-1)\right]\right\} - \theta(p). \tag{14}$$

Differentiating (14) with respect to k and p gives the same first-order condition for k as before in equation (3), but changes the firm's incentives to shift profits. The firm's optimal transfer price is now implicitly defined by

$$\theta'(p) = t^*(1-t). \tag{15}$$

Since the RHS of (15) must be positive, the overhead service will always be overinvoiced ($p > 1$) in order to reduce the international double taxation of foreign profits implied by the tax deduction scheme.

Under the tax deduction method the tax base of the home country (still denoted by T) consists of declared profits by the parent plus declared profits of the subsidiary after the deduction of foreign taxes. The government's budget constraint then is

$$t\left\{f(k,g) + (p-1) - rk + (1-t^*)\left[\bar{R} - (p-1)\right]\right\} \equiv tT = g.$$

As before, the government maximizes the net rents derived from providing the public good, subject to the governments budget constraint. The Lagrangian is

$$\begin{aligned}\mathcal{L} &= (1-t)\left\{(f(k,g) + [p(t)-1] - rk) + (1-t^*)\left[\bar{R} - (p(t)-1)\right]\right\} \\ &- \theta(p) + \lambda(tT - g).\end{aligned}$$

The first order condition with respect to the public input remains unchanged from (6), but the optimality condition for the corporate tax rate is now different. Under the tax deduction scheme it becomes

$$\lambda = T \Big/ \left(T + t\frac{\partial p}{\partial t}\,t^*\right) = T \Big/ \left(T - t\frac{(t^*)^2}{\theta''}\right), \tag{16}$$

where the second step has used eq. (15) to implicitly differentiate $\partial p/\partial t$. In conjunction with (6), the final condition for the optimal use of t and g is then

$$f_g = 1 \Big/ \left[1 - \frac{(1-t)\, t\, (t^*)^2}{T\, \theta''} \right] > 1. \tag{17}$$

Comparing (17) with (8), it is clear that public inputs are still undersupplied (for strictly positive levels of t^*), but the excess burden of a higher corporate tax rate is now mitigated by two effects. Firstly, the firm's incentive to shift profits in response to a tax rise in the home country is reduced since tax savings only arise to the extent that t^* shields foreign income from the higher domestic tax rate. Comparing (15) above with (4) in section 2, it is immediately obvious that, for $t^* < 1$, equation (15) implies the smaller absolute response of the transfer price to a rise in t. Secondly, for a given level of profit shifting, the effect on the home country's tax base is now reduced in comparison to pure source taxation, since the home country only gives up the deduction for the source taxes paid abroad.

Some further insights can be gained by considering the tax deduction method as an intermediate regime, where the mix of source and residence taxation depends on the foreign tax rate t^*. If $t^* = 0$, the residence principle of taxation is effectively in operation. It is evident from (17) that the provision of the public good is efficient in this case, since no incentives remain for the firm to use the transfer price as a profit shifting device. As t^* rises, the element of source taxation increases and the undersupply of public inputs becomes more severe. In the extreme, if t^* approaches unity, we are back to our analysis of section 2.

In summary, the analysis of alternative international tax principles shows that only pure residence taxes can guarantee the efficiency of public input provision when integrated firms can manipulate their national profit tax bases. Where source taxes exist and governments have to act unilaterally, the tax deduction method is able to limit the incentives for transfer pricing, even though some excess burden of taxation remains. Similar results in favour of some international double taxation also emerge from other models of strategic capital taxation where profit shifting is not explicitly modelled (Bond and Samuelson, 1989; Konan, 1997). However, the policy relevance of these results should not be overstated since the tax deduction method plays only a very limited role in the existing international double taxation treaties. The main argument against this scheme is, of course, that the double taxation of foreign-earned

income implies a general discrimination against international investments and thus runs counter to the liberalization of international capital markets.

5 Conclusions

This paper has evaluated the implications for the national provision of public inputs when profit shifting in multinational enterprises is a relevant constraint for tax policy. It is then possible for international firms to locate in one country and benefit from that country's favourable public infrastructure, but avoid high corporate tax rates through profit shifting to other, low-tax jurisdictions in which the firm operates. We have seen that, in our benchmark case of pure profit taxation and the source principle in operation, public inputs will be unambiguously underprovided in the presence of profit shifting. However, when the capital tax also distorts the firm's investment decision, and capital and the public input are complements in production, then raising the supply of public inputs serves to counteract the existing distortion in the capital market. Depending on the strength of the complementary relationship, the underprovision result therefore may, in this case, be turned around. However, underprovision may also become more severe as the excess burden of taxation will generally increase, making the supply of public inputs more expensive. Finally, we have considered different forms of partial residence taxation, in particular the tax deduction method. Under this scheme the underprovision of public inputs will be less pronounced than under pure source taxation, but the result is qualitatively unchanged as long as the foreign tax rate is strictly positive.

Overall, our analysis indicates that the adverse effects of non-cooperative capital taxation on the provision of public infrastructure may be more severe than is found in most of the recent theoretical literature on this subject. Furthermore, from a policy perspective, it seems clear that the danger of being 'exploited' by multinational corporations is especially great in the European Union, where a large amount of trade occurs within MNCs and public infrastructure levels and capital tax rates are relatively high. If one does not believe in the EU-wide harmonization of public expenditure levels (which would entail the well-known 'third-country problem', since competition for paper profits is not limited to the European Union), then the policy solution must be to reduce the possibilities and the incentives for MNCs to engage in international profit shifting.

As is well known, one possible approach would be a worldwide application of the Formula Apportionment system (FA) currently employed by Canada, Switzerland, and the U.S. for taxing their domestic firms. The FA scheme, in effect, apportions assets, sales, and/or payroll to any individual state in which a firm operates and then uses these shares to compute the base applicable for taxation in that state. The FA scheme is seen by many as a superior method of taxing multinationals, since it ensures that MNCs cannot evade taxation in any single state in which they operate. However, as shown by Nielsen, Pascalis-Møller and Schjelderup (1999), whether the FA scheme indeed discourages strategic profit shifting by multinationals depends on the nature of competition in national markets. Under monopoly conditions, transfer pricing incentives are eliminated if the FA scheme applies, but the incentives reappear under oligopolistic competition and are even aggravated for reasonable values of national tax rates. An alternative would be for the EU to adopt the 'comparable profits method' that the U.S. currently employs for its international businesses. However, this scheme has other disadvantages, as it can be abused as an instrument of protectionism and strategic trade policy (see Schjelderup and Weichenrieder, 1999).

As pointed out by Mintz (1999) the increased internationalization of business activity, combined with the shortcomings of allocation methods and transfer price regulation, will most likely lead to one of two possible outcomes. Either governments will stop taxing corporations altogether, or efficiency, fairness and other political reasons will ensure the continued interest in taxing corporate income. In the latter case governments can be expected to either improve on the methods used to regulate arm's length transactions between related parties, or to coordinate corporate income taxes worldwide.

Appendix

In this appendix we show that the optimal corporate profit tax rate t will be strictly between zero and unity, and hence eq. (8) indeed implies an underprovision of public inputs.

For this purpose, we use the government budget constraint (5) in the net profit equation (2) to substitute out for g. Hence

$$\Pi^N = (1-t)\left[f\left(k,\ t\,T(t)\right) + \left[p(t) - 1\right] - r\ k\right] + (1-t^*)\left[\bar{R} - \left[p(t) - 1\right]\right] - \theta\left(p\right). \quad \text{(A.1)}$$

As a preliminary step we calculate dT/dt, which includes the effect on the domestic tax base of a higher level of g that is financed by the tax increase. From the government budget constraint [eq. (5)] we know that

$$g = t\,T = t\ \left[f\left(k,\ t\,T\right) + p\left(t\right) - 1 - r\ k\right]. \quad \text{(A.2)}$$

Totally differentiating this expression and rearranging gives

$$\frac{dT}{dt} = \frac{f_g\,T + (dp/dt)}{(1 - t\ f_g)}\ . \quad \text{(A.3)}$$

Note that the denominator of (A.3) is strictly positive under the assumption of decreasing returns to scale.[14] From the Euler equation we get $f_k\ k + f_g\ g + \pi = \mathrm{f}$, where π denotes residual profits (the return to the fixed factor). Using this in the government budget constraint (A.2) and dividing by g gives $t\,f_g = 1 - [t(\pi + p - 1)/g]$. This is positive when profit shifting is limited by sufficiently high transaction costs (see footnote 9 in the main text).

Differentiating (A.1) with respect to t, using the envelope theorem and (A.3) yields

$$\frac{d\Pi^N}{dt} = -T + (1-t)\ f_g\left[T + t\ \frac{f_g\,T + (dp/dt)}{(1 - t\ f_g)}\right] = 0. \quad \text{(A.4)}$$

Dividing (A.4) by T, using $dp/dt = -1/\theta''$ and rearranging we arrive at

$$\frac{(1-t)\ f_g}{(1 - t\ f_g)}\left(1 - \frac{t}{\theta''\,T}\right) = 1,$$

which can be further reduced to reproduce eq. (8) in the main text.

[14] We thank Thomas Dickescheid for pointing out this argument to us.

It is straightforward to evaluate (A.4) for $t = 0$ and $t = 1$, respectively:

$$\left.\frac{d\Pi^N}{dt}\right|_{t=0} = T\left[f_g(0) - 1\right] > 0, \tag{A.5}$$

$$\left.\frac{d\Pi^N}{dt}\right|_{t=1} = -T < 0. \tag{A.6}$$

where terms are signed using our assumption that the tax base T is positive (cf. footnote 9) and the Inada condition $f_g(0) \to \infty$.

As usual, it is difficult to give a general proof that the second-order condition for a maximum will be fulfilled. But assuming that this is the case, and hence that Π^N is concave in t, it is then immediately implied by (A.5) and (A.6) that $0 < t < 1$ must hold in the optimum, with strict inequalities on both sides.

Intuitively, it is clear that $t = 0$ cannot be optimal since the marginal productivity of the first unit of g will be infinitely high under the assumed Inada conditions. On the other hand, if t were equal to one, then the firm's net profits in the home country would be zero. Since the only purpose of levying taxes in the present model is to maximize the net profits of the representative firm (by financing a public input which raises gross profits by more than the tax burden), this clearly can also not be an optimal policy.

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