

Company Taxation and Tax Spillovers: Separate Accounting versus Formula Apportionment

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Abstract

It is observed in the real world that taxes matter for location decisions and that multinationals shift profits by transfer pricing. The US and Canada use so-called Formula Apportionment (FA) to tax corporate income, and the EU is debating a switch from Separate Accounting (SA) to FA. This paper develops a theoretical model that compares basic properties of FA to SA. The focal point of the analysis is how changes in tax rates affect capital formation, input choice, and transfer pricing, as well as on spillovers on tax revenue in other countries. The analysis shows that a move from SA to FA will not eliminate such spillovers and will, in cases identified in the paper, actually aggravate them.

JEL classification: F24, F36, H25, and H87

1 Introduction

Does competition over mobile investments, shifty multinational profit, and fiscal externalities across countries necessitate a transition from the most commonly used system of corporate taxation, Separate Accounting (SA), to Formula Apportionment (FA), the type of corporate tax system used in federal countries such as the U.S. and Canada?¹ One answer to this question is provided by the European Commission (Commission 2001a,b), which recommends a transition from SA to FA taxation in order to level the playing field for business competition within the European Union. This recommendation is also in line with the advice given by several prominent economists, who have advocated the FA system on the grounds that it is more robust to the fiscal externalities created by competition over investment and profit, as well as issues concerning double taxation.²

This paper argues against the above presumption in favor of Formula Apportionment by comparing it to Separate Accounting. The central idea behind an FA system is that a corporation should consolidate the income of its affiliates into a single measure of taxable (global) income, which is then allocated among jurisdictions according to a common formula reflecting the corporate group's activity within each jurisdiction. In contrast, under a SA system each individual country computes the income generated by firms located within its jurisdiction (which can be entities of multinationals) using arm's length prices on intra-firm transactions, and subsequently applies the national tax rate to it.³ A significant difference between the

¹For an extensive outline of the FA system in Canada and the U.S. see Weiner (1998).

²Advocates for a transition from SA to FA are among others Musgrave (1973), Bird and Brean (1986), McLure (1989), Bucks and Mazerov (1993) and Shackelford and Slemrod (1998).

³A simple example may illustrate the workings of Separate Accounting and Formula Apportionment. Consider a Finnish company that has its sole subsidiary in Sweden. The entity in Finland employs 70 pct. of total capital and stands for 70 pct. of total payroll, but has only 40 pct. of total sales, the remainder registered by the Swedish entity. Under SA, the company would compute the income of each of its two entities (using Finnish and Swedish tax law, respectively) for separate taxation in Finland and Sweden. Under FA with equal weight (1/3) assigned to relative capital, relative payroll and relative sales, the company would first compute total income in the two entities, whence 60 pct. ($= \frac{1}{3}(0.7) + \frac{1}{3}(0.7) + \frac{1}{3}(0.4)$) of it would be allocated for taxation in

two tax principles, therefore, is that the SA system is based on *reported income* whilst taxation under the FA system is based on *reported activity*. We show that these fundamental characteristics introduce different tax spillovers across countries under the two tax systems which makes it impossible to unambiguously favor one system over the other. In particular, we show that the relative strength of tax spillovers under the two regimes depends on (a) how costly it is for MNEs to undertake transfer pricing, and (b) how much pure profit the MNEs generate. These considerations also determine whether SA or FA implies the higher level of tax in a non-cooperative equilibrium, and in the end which of the two schemes is preferable from an international perspective.

These results are brought forth using a framework with two countries embedded in a larger world economy. The model portrays multinationals (MNEs) with a parent firm in one country and a subsidiary in the other. These MNEs produce an output using a common input and (plant-specific) capital. The common input is acquired by the parent company and made available also to the subsidiary at a (transfer) price. Under simplifying assumptions concerning symmetry we derive the effects of corporate income tax increases on the choice of capital and common inputs, as well as on transfer pricing. Of special interest is how an increase in the corporate tax in one country affects capital stocks on the part of firms in the other country. This information is then used to derive how the tax increase affects tax revenue in the other country and hence the character of the spillovers of tax policy.

A main issue is whether spillovers are more pronounced under SA than under FA, and whether choosing one system or the other is likely to lead to too high or too low rates of corporate income taxation in the two countries. We investigate these issues in a situation in which countries can agree on the international tax principle, i.e. SA or FA, but set their tax rates noncooperatively. The assumption that countries can agree on tax principle, but not tax rates is in line with observations of tax systems in the real world. Almost all countries have chosen the SA system, whilst only a handful of countries, all being federal in structure, uses the FA system. Neither in countries using the SA system, nor in countries using the FA system, have

Finland, and 40 pct. in Sweden.

capital income taxes been coordinated or harmonized. This is an observation that is suggestive of focal point coordination of tax principle rather than of tax rates. The lack of coordination of statutory capital tax rates may be explained by differences among countries related to the need for tax revenue, preferences for distribution, or the desire to use the tax system to attract investments (as indeed is the case for tax havens). These differences in opinion among countries concerning tax rate harmonization have been exemplified by the strong resistance among a wide range of EU countries to capital tax rate coordination within the European Union.

Only a few studies exist which examine the mechanics and economic consequences of taxation according to FA. McLure (1980) first demonstrated that formula apportionment transforms the state corporate income tax into three separate taxes on the factors in the apportionment formula. Accordingly, state authorities face incentives to modify the weights used in the formula in order to stimulate employment and investment in their own state.⁴ Gordon and Wilson (1986) show that FA may seriously distort producer prices if national tax bases are not harmonized internationally. They find, for example, that if allocation is mainly tied to capital formation (or property), price distortions will differ among firms, creating incentives for mergers. When allocation is based on payroll taxes they identify opposite incentives in that mergers among firms producing different goods are discouraged. The tax system in this case creates incentives for production to locate in low tax countries with sales in high tax countries, and conversely. Finally, they show that in equilibrium nations will choose inefficiently low tax rates. This latter result is analysed in detail in a paper by Anand and Sansing (2000). They show that while the harmonised apportionment rule will prevail as the cooperative solution to a game between two states, a state can increase its welfare by deviating from this cooperative solution, i.e. a typical Prisoner's Dilemma situation.

Our paper differs from those above in that it carries out a direct comparison

⁴Goolsbee and Maydew (2000) have empirically documented the negative externalities on other states associated with changes in the weights of the apportionment formula. Their results provide evidence for the superiority of a harmonised formula apportionment rule.

of Separate Accounting and Formula Apportionment.⁵ The paper is structured as follows. Section 2 sets up a simple model of a MNE operating in two countries. In section 3 the properties of SA are derived, and in section 4 a similar analysis is carried out for FA. Section 5 then provides a thorough comparison of SA and FA. Section 6 demonstrates that similar results are obtained under welfare maximization and under tax revenue maximization. Finally, we conclude in section 7.

2 The model

Consider two countries, A and B , that together form only a small part of the world. Each country is the host of a multinational firm which owns a subsidiary in the other country. The two multinationals are assumed to be symmetric in their structure. For convenience, we will use capital (small) letters to denote the activities of the firm which has its headquarters in country $A(B)$ (to be called firm A and B , respectively). Both MNEs produce a single good in each location using capital (K, k) and a common input (S, s). The production structure of each affiliate of a MNE is assumed to be the same. The price of the final good as well as the common input is normalized to unity.⁶ The input is common in the sense that the parent firm's use of it does not diminish its use by the affiliate, and vice versa. Thus the input is really a "private public" good.⁷ The parent firm charges its affiliate a fee of (G, g) per unit of the common input. The true price of the common input for each firm is 1; however, the price charged by the parent may, for profit shifting purposes, be above or below the true price of the input, i.e. the MNE engages in transfer pricing.

In principle, costs associated with transfer pricing can take the form of fines when transfer pricing is detected by authorities, and resource costs associated with hiring lawyers and accountants to defend the chosen transfer prices. Here we shall

⁵A direct comparison of the two tax systems is also the theme in Nielsen et al. (2003) who compare transfer prices when product markets are characterised by imperfect competition.

⁶In other words, these input and output markets are for simplicity taken to be perfectly competitive.

⁷Examples of common inputs could be headquarter services, management expertise, or R&D activities.

take the first route; the second is explored in the Appendix, and it yields equivalent results. Referring to the symmetry of the two MNEs and their affiliates, we only need to describe firm A in detail in what follows. Transfer pricing has the potential to lower taxes for MNEs, but it is not costless.

Accordingly, transfer pricing involves the probability of a fine (z) set by the country which is cheated against, i.e. the high tax country. Throughout the article we shall, with no loss of generality, assume that country B is the high tax country (with a tax rate as least as high as country A 's). The probability of being detected for transfer pricing is taken to be a convex function of the deviation of the transfer price from its true value, that is, the probability of detection is given by $p(G - 1)$, with $p(0) = p'(0) = 0, p > 0$ (for $G \neq 1$), $p'' > 0$.⁸ If detected, the fine z is levied on the size of the shipment (S) times the overpricing ($G - 1$), times the high tax rate (t_B), i.e., altogether $zS(G - 1)t_B$. The expected cost of transfer pricing abuse is thus the product of the detection probability and the fine. We can write this product as $zSt_B\Phi$, where the Φ function contains both the degree of abuse ($G - 1$) as well as the probability of detection p , so that $\Phi = (G - 1)p$. Note that $zSt_B\Phi$ includes the evaded tax, so that z is at least unity.

If tax authorities in country B detect transfer pricing and adjust taxable income of the MNE in B , it is possible that the authorities in country A undertake a corresponding correction of the MNE's taxable income there. The extent to which this is expected to happen is indicated by x which lies between zero and one. The expected addition to profits of the entity in country A associated with this corresponding correction is then $xSt_A\Phi$, t_A being country A 's tax rate.

Let R be the world rental rate of capital.⁹ Since prices are normalized to unity, we have that pre-tax profits of the firm with headquarters in A and subsidiary in B are, respectively

$$\Pi_A = F(K_A, S) + (G - 1)S - RK_A + xSt_A\Phi. \quad (1)$$

$$\Pi_B = F(K_B, S) - GS - RK_B - zSt_B\Phi. \quad (2)$$

⁸Note that the above assumptions imply that $p' > 0$ when $G > 1$ and $p' < 0$ when $G < 1$.

⁹Investment in the two entities for simplicity is financed exclusively by equity, where the required return is the world rental rate of capital, R .

Note that F represents the common production structure of the two entities. If the governments in countries A and B tax the MNE, they can do so by either using separate accounting or formula apportionment. We start by looking at the implications of the former principle.

3 Separate Accounting (SA)

Most countries use SA to determine profits of a MNE. An affiliate of a MNE is subject to taxation in the jurisdiction of location, if the affiliate is a separate and independent entity. In that case, taxable profits are derived from the firm's books, with the exception of the possible use of an arm's length standard to correct for the value attached to intra-firm trade. This means that if the price used by the MNE on its intra-firm transactions does not correspond to the price that would have occurred, had the parties been truly independent entities, then the transaction may be revalued by the taxing authority.¹⁰

We assume that the rental price of capital and costs associated with transfer pricing are not deductible from tax.¹¹ Then global after-tax profits of the MNE are

¹⁰In practice it is very difficult to find the correct transfer price, either because there may be no comparable 'market' price or because the cost structure of the exporting firm is private information (thus making it difficult to derive a 'synthetic' price). If goods take on the character of intangibles, problems become aggravated by the uniqueness of the good. In such cases authorities find it especially difficult to argue that the item has been either overinvoiced or underinvoiced, whence the MNE may get away with a distorted transfer price when incurring some extra costs.

¹¹A number of capital exporting countries give a tax credit upon repatriation for foreign taxes paid. However, given the possibilities of deferral and the use of limited credits, it is generally agreed that the source principle of taxation is effectively in operation (see e.g. Tanzi and Bovenberg 1990, and Keen 1993).

under SA¹²

$$\begin{aligned}\Pi^{SA} = & (1 - t_A) [F(K_A, S) + (G - 1)S] \\ & + (1 - t_B) [F(K_B, S) - GS] - RK - (zt_B - xt_A)St_B\Phi.\end{aligned}\quad (3)$$

The MNE maximizes (3) by choosing its transfer price (G), its country specific capital (K_i), and its use of the commoninput (S). Given the intangible nature of the common input, the MNE can use its transfer price to shift profits between the two countries. This does not mean that it shifts all profits to the low-tax country. The reason is the (expected) costs that accrue under transfer pricing. Thus, at the optimum, the headquarters of the MNE balance the marginal gains from profit shifting against the costs, yielding a first order condition for G as follows,

$$\frac{\partial \Pi^{SA}}{\partial G} = 0 \implies t_B - t_A = \Phi'(zt_B - xt_A).\quad (4)$$

The first order condition in (4) is easily interpreted; it equates the marginal benefits of transfer pricing (i.e. the tax savings) to the marginal costs (i.e. the (net) fine). It is easy to see that when $t_B = t_A$, then $\Phi' = 0$ and thus $G = 1$. Moreover, the common input will be overinvoiced ($G > 1$), if $t_B > t_A$; in this case the transfer price increases the firm's costs in the high tax country and the firm's income in the low tax country.

The first order conditions for the use of inputs are:

$$\frac{\partial \Pi^{SA}}{\partial K_i} = 0 \implies (1 - t_i) F_1^i = R, \quad i = A, B,\quad (5)$$

$$\frac{\partial \Pi^{SA}}{\partial S} = 0 \implies (1 - t_A) F_2^A + (1 - t_B) F_2^B = 1 - t_A - G(t_B - t_A) + (zt_B - xt_A)\Phi,\quad (6)$$

where $\partial F/\partial K_A = F_1^A$ (and similarly for K_B and S).

The two first order conditions given by (5) have the usual interpretation of equating the after-tax marginal product of capital to the user cost of capital. Equation

¹²The two governments and the MNE are engaged in a two-stage game. At stage one the governments choose tax rates non-cooperatively and at stage two the MNE chooses its use of capital, public input, and the extent of transfer pricing. This section analyses the second-stage decisions while the first-stage decisions are analysed in subsection 3.1.

(6) equates the after-tax contribution of the public input to production to the net of tax cost of using this input. The latter includes the costs and benefits of using the input for profit shifting purposes.

Throughout the paper we will concentrate on the special case in which taxes initially are equal ($t_A = t_B = t$). We will then examine the implications of a small tax increase on the behaviour of the multinational firm. The assumption of identical taxes simplifies formulas considerably, while allowing us to derive some general characteristics of corporate income taxation according to SA.

With identical tax rates at the outset, the incentive to shift profits by transfer pricing vaporizes (see (4)), the marginal productivity of capital will be equalized across countries, i.e. $F_1^A = F_1^B$ (see (5)), and the common input is used only to maximize global production, i.e. $F_2^A + F_2^B = 1$ (see (6)). Equal taxes (and an identical production structure with a common input) also mean that the level of the capital stock will be the same in each country. Under these circumstances, all first and second derivatives of the production functions for the parent and the subsidiary will be equal, whence we may dispense with superscripts for the remainder of this section.

Total differentiation of first order conditions (4), (5) and (6) implies, together with symmetry, the following responses in transfer prices, capital stocks and inputs to changes in tax rates:

$$\frac{dG}{dt_A} = -\frac{1}{(z-x)t\Phi''} < 0, \quad \frac{dG}{dt_B} = \frac{1}{(z-x)t\Phi''} > 0, \quad (7)$$

$$\begin{aligned} \frac{dK_i}{dt_i} &= \frac{F_1(2F_{22}F_{11} - F_{12}^2)}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\ \frac{dK_i}{dt_j} &= \frac{F_1F_{12}^2}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\ \frac{dS}{dt_i} &= -\frac{F_1F_{12}}{2(1-t)(F_{22}F_{11} - F_{12}^2)} \end{aligned} \quad (8)$$

where $i, j = A, B, i \neq j$, and where the production structure is assumed to imply $(F_{22}F_{11} - F_{12}^2) > 0$. As to the signs and relative sizes of these derivatives, we note from (8) that

$$\frac{dK_A}{dt_A} = \frac{dK_B}{dt_B} < \frac{dK_A}{dt_B} = \frac{dK_B}{dt_A} < 0, \quad \frac{dS}{dt_i} < 0, \quad i = A, B. \quad (9)$$

The inequalities in (7) show the direct effect of a tax change on the transfer price: if t_A (t_B) goes up, it becomes more (less) costly to overinvoice and the MNE now wants to accumulate profits in B (A) by reducing (increasing) the transfer price. The inequalities in (9) show that an increase in the tax rate of country i has a stronger negative effect on the capital stock of the firm in country i , but the cross-effect on capital in country j is also negative. Furthermore, a rise in the rate of tax in either country leads to a fall in the use of the common input. To understand these effects note that an increase in country i 's tax directly raises the required before tax marginal productivity of the capital stock in country i , and thus lowers the stock of capital in that country. A reduced capital stock in country i decreases the marginal productivity of the common input S , the use of which therefore likewise is reduced. Less use of the common input in production in country j reduces the marginal productivity of capital there, lowering the stock of capital employed.

Recall that as the MNE based in country B is a mirror image of firm A , all the analysis above carries over to the former, with appropriate notational changes. Thus, given the outline of the basic model and the comparative statics results, we are now in a position to examine how taxes affect national tax revenue. That is the topic of the next subsection.

3.1 Tax spillovers under SA

Much of the discussion on taxation of multinationals has evolved around how national tax policy in one single country may impose externalities on other countries. Here we investigate this question in further detail. The objective on the part of tax authorities behind levying corporate income taxes may be to maximize some notion of national welfare, or it may simply be to maximize revenue from the tax. In line with a large literature in public finance, we initially assume revenue maximization. In section 6, however, the objective is the maximization of welfare. We are able to demonstrate there that under conditions of balanced ownership of MNEs, entirely equivalent results can be obtained.

Taking into account both the parent company of firm A and the affiliate of firm B ,

country A 's tax revenue is written as $V_A = t_A [F(K_A, S) + (G - 1)S + f(k_A, s) - gs] - xt_A(\Phi S + \phi s)$. It consists of taxes on profits of the home-parent firm and the foreign-subsidary firm (the first term), minus the correction associated with country B 's transfer-pricing penalties of both firms (the second term). Under revenue maximization, a marginal change in the tax rate of country B , say, changes tax revenue in country A as follows (starting from the initial equilibrium with equal tax rates)¹³,

$$\frac{dV_A}{dt_B} = 2t_A \left[F_1 \frac{dK_A}{dt_B} + S \frac{dG}{dt_B} \right], \quad (10)$$

Having shown that $dK_A/dt_B < 0$ and $dG/dt_B > 0$, we may state:

Proposition 1 *Starting from the symmetric tax equilibrium, an increase in the tax rate of country B has an ambiguous effect on tax revenue in country A .*

To explain the intuition behind the proposition it suffices to focus on the MNE based in country A . An increase in t_B leads the MNE to raise its transfer price ($dG/dt_B > 0$, see (7)). This has the effect of moving some profits from the subsidiary to the parent company, thus raising the tax base in country A (i.e. a positive externality). At the same time, however, the term dK_A/dt_B is negative, see (9). It represents the effect on production capacity in country A of a change in t_B . This spillover is obviously negative, and it is numerically greater, the greater is F_{12} , and the smaller is F_{11} , i.e. the more cooperative the two production factors (capital and the common input) are, and the less concave the production structure is. In fact, the size of this negative spillover is completely governed by properties of the production structure.

Note that the fiscal externality that pertains to the widening of the tax base will, other things equal, lead to too low tax rates in the tax equilibrium since neither country takes this effect into account. In contrast, overlooking the negative spillover effect makes authorities impose a too high tax, *ceteris paribus*. Whether tax rates will be set too low or too high in equilibrium then will depend on the relative magnitudes of these effects.

¹³A more detailed derivation of (10), which heavily exploits the symmetry of our framework, is given in the Appendix.

3.1.1 A Cobb-Douglas example

In order to gain more intuition for formulas here and in subsequent sections we shall repeatedly consider a Cobb-Douglas example.

Specifically, assume that the production function $F(\cdot)$ is Cobb-Douglas and given by $F(K, S) = K^\alpha S^\beta D^\gamma$, with $\gamma = 1 - \alpha - \beta$. The term D^γ can be interpreted as just a constant, in which case we deal with a production structure featuring decreasing returns to scale, or alternatively as the contribution from a suppressed third factor of production D (which could be land, firm-specific management, etc.). In what follows we shall allude to the latter interpretation of the term.

With the Cobb-Douglas production structure, the expression in (10) becomes

$$\frac{dV_A}{dt_B} = 2\beta Ft \left[\frac{2}{(z-x)t\Phi''} - \frac{\alpha^2}{2(1-t)\gamma(1-\alpha)} \right] \quad (11)$$

From (11) it is seen that the cross-effect on revenue in country A from a tax increase in B becomes positive for a very low value of $(z-x)t\Phi''$, which is the unit expected cost of transfer-pricing abuse. If transfer pricing is virtually costless, the tax increase under consideration will induce a large shift of taxable income from country B to country A and hence make for a positive revenue externality. At the other extreme, if $(z-x)t\Phi''$ is very high, transfer pricing will not be used. But the tax increase will lower the use of the common input and of capital in both entities of the MNE; this will lower taxable income in country A and thus render the revenue externality negative. Further, a low value of γ , indicating that the hidden factor of production (or rents) is unimportant, will make capital employment extremely sensitive; in this situation, the tax increase in B sharply reduces capital use in A and hence tax revenue there.

Finally, we note that the cross-effect on revenue is proportional to the factor share of the common input β . Hence, the less important is the common input, the smaller is the net revenue externality under SA.

Summing up, the net tax spillover under SA depends on the relative magnitudes of a positive and a negative externality that arise if one country increases its tax rate. In the Nash equilibrium, tax rates may therefore be either too low or too high depending on the relative strengths of these two effects.

4 Formula Apportionment (FA)

In this section we consider the implications of corporate income taxation following Formula Apportionment (FA) as an alternative to Separate Accounting.

In allocating a share of a multinational enterprise's global income to any specific jurisdiction, FA may utilize information on the relative capital stock employed in that jurisdiction, the relative sales there, and the relative payroll there. With a broad formula with all three factors present, the effects of tax policy would be multi-faceted, in that the consequences for capital accumulation, employment and sales would all have to be accounted for. However, the main thing is that the average (weighted) tax burden will rise following a tax increase, and this is well captured by a more narrow formula containing only one factor, say capital. Thus, for simplicity we consider only a simple variant of FA, in which the capital stock is the sole factor entering the sharing formula in the FA. We likewise assume that the FA arrangement makes use of the same definition in both countries for the multinational's global taxable income; the rates chosen in the two countries may in principle differ, though.¹⁴

To explain the mechanics of FA we again rely on symmetry and focus on the MNE based in country A . Under FA the before-tax profits on the part of its two entities of the MNE are $\Pi_A + \Pi_B$, and taxable income in each country is divided according to the capital stock in that country as a share of the MNE's world-wide capital. The MNE's profit tax liability, T_i , in either country is thus

$$T_i = t_i \frac{K_i}{K} [F(K_A, S) + F(K_B, S) - S]. \quad (12)$$

After-tax profits are accordingly given by

$$\begin{aligned} \Pi^{FA} &= (\Pi_A + \Pi_B) - T_A - T_B, \\ &= (1 - T)[F(K_A, S) + F(K_B, S) - S] - RK - (zt_B - xt_A)S\Phi. \end{aligned} \quad (13)$$

¹⁴Observe that our simple formulation implies that the countries use the same formula apportionment rule, and thus there already exists rule harmonization. Thus, our setup abstracts from the issues examined in, e.g., Gordon and Wilson (1986) and Goolsbee and Maydew (2000), and focuses on the issues that the EU proposal gives rise to.

where $T \equiv \frac{K_A}{K}t_A + \frac{K_B}{K}t_B$ is the average effective tax rate on the part of the MNE. Note that the transfer price set by the multinational has no bearing on the definition of the tax base for use in either country. Hence, in order to maximize after tax profits, the MNE will wish to set G equal to its 'true' value of one. Accordingly, transfer pricing is not present under Formula Apportionment.¹⁵

To find the MNE's choice of capital stocks and quantity of the common input we derive the first order conditions for maximization of after-tax profits.¹⁶ The conditions are:

$$\frac{\partial \Pi^{FA}}{\partial K_i} = (1 - T) F_1^i - [F(K_A, S) + F(K_B, S) - S] \frac{K_j}{K^2} (t_i - t_j) - R = 0, \quad (14)$$

$$\frac{\partial \Pi^{FA}}{\partial S} = (1 - T) [F_2^A + F_2^B - 1] - (zt_B - xt_A)\Phi = 0 \quad (15)$$

The first order conditions in (14) for the choice of capital stocks are more complicated than under SA (compare with (5)), as they contain an extra term. A rise in, say, K_A , directly increases the (after-tax) marginal product of capital as well as the total user cost of capital. In addition, it induces a change in the average tax rate which will tend to fall, if $t_A < t_B$, raising the after-tax marginal contribution of capital to profits. This effect is captured by the second term on the right hand side of (14). Since transfer pricing is not present and $G = 1$, the first order condition for S becomes particularly simple here $-F_2^A + F_2^B - 1 = 0$ - i.e., the sum of marginal productivities has to equal unity. No extra term reflecting costs and benefits of transfer pricing (viz. (6)) appears.¹⁷

In the following we focus on the case of initially identical rates of tax ($t_A = t_B = t$ and hence $t = T$). Totally differentiating the first order conditions we derive formulas

¹⁵To see this formally, derive the first order condition for G . The result is $\Phi' = 0$, which implies that $G = 1$.

¹⁶Again, as in the SA case, there is a two-stage framework in the background. The decisions taken at the second stage are presented here, while the decisions taken at the first stage are presented in subsection 4.1.

¹⁷Note that with equal taxes the values entering the first order conditions for the MNE are the same irrespectively of whether it operates under a SA or a FA regime. However, as we shall see, the comparative statics results, and hence the externalities, are markedly different in the two cases.

for how capital stocks and common input choice are affected by tax changes (a fortiori assuming identical taxes at the outset),

$$\begin{aligned}
\frac{dK_i}{dt_i} &= \frac{F_1 F_{22} F_{11} + (F_{22} F_{11} - F_{12}^2)(2F - S)/K}{2(1 - T)F_{11}(F_{22} F_{11} - F_{12}^2)} \\
\frac{dK_i}{dt_j} &= \frac{F_1 F_{22} F_{11} - (F_{22} F_{11} - F_{12}^2)(2F - S)/K}{2(1 - T)F_{11}(F_{22} F_{11} - F_{12}^2)} \\
\frac{dS}{dt_i} &= -\frac{F_1 F_{12}}{2(1 - T)(F_{22} F_{11} - F_{12}^2)}
\end{aligned} \tag{16}$$

From (16) we can conclude that

$$0 > \frac{dK_A}{dt_A} = \frac{dK_B}{dt_B} < \frac{dK_A}{dt_B} = \frac{dK_B}{dt_A}, \quad \frac{dS}{dt_i} < 0, \quad i = A, B. \tag{17}$$

The inequalities in (17) relate that under SA, the effect of a tax increase on the MNE's capital stock in the same country is negative. Different from under SA, the sign of the cross-effect on capital employed in the other country is now ambiguous (cf. (8)). This is seen from (16) by examining the numerator of dK_i/dt_j . It can then be seen that the numerator may become negative if its second term dominates the first. This will happen if the remuneration of suppressed production factors of the MNE in the two countries (relative to the stock of capital), $(2F - S)/K - F_1$, is large, and if F_{12} as an indicator of how cooperative capital and the common input are, is small.

The intuition for the ambiguity as to the cross-effect on capital is as follows: On one hand, the increase in the tax in country j raises the average effective tax rate, t . As overall capital now is more heavily taxed, its after-tax marginal productivity falls, and this leads to a reduction in overall capital in both countries. On the other hand, since the tax in country i is now smaller than that in country j , the average effective tax can be lowered through a relative increase in the capital stock in country i , relative to that of country j . This is more attractive, the higher are pure profits from production. If the second effect dominates the first, the cross-effect on capital in country i of the tax increase in country j will be positive, and vice versa.

In the Cobb-Douglas example from section 3, dK_i/dt_j can be found to be proportional to the expression $[2\gamma - \alpha(1 - \alpha)]$, which clearly has an ambiguous sign.

Again, however, if the share of rents, γ , is large, a positive cross-effect on capital is guaranteed.

From (8) and (16) we deduce that the effect of a tax increase in any country on the use of the common input is the same under FA and SA, and that the effect of a coordinated tax increase on the stock of capital in either country (or, alternatively, the effect of a tax increase in one of the two countries on total capital employed by the MNE) likewise is the same under the two international tax regimes. Given our symmetry assumptions, this is what we should expect.

4.1 Tax spillovers under FA

In a similar fashion as in the previous section we may now examine the effect on tax revenue in country A from a tax increase in country B .

Incorporating the subsidiary of the MNE based in country B , we define tax revenues in country A as

$$V_A = t_A \frac{K_A}{K} [F(K_A, S) + F(K_B, S) - S] + t_A \frac{k_A}{k} [f(k_A, s) + f(k_B, s) - s] - x t_A (\Phi S + \phi s),$$

i.e. the tax rate times the proportion of the home and of the foreign MNE's global profits that is apportioned to country A according to the capital employed in country A (the two first terms), minus the probability-contingent compensating correction for transfer pricing for both firms (the third term). Under the assumption of symmetry, the effect on tax revenue in A from a marginal change in t_B is then,¹⁸

$$\frac{dV_A}{dt_B} = 2t_A \left[(F(K_A, S) + F(K_B, S) - S) \left(\frac{K_B \frac{dK_A}{dt_B} - K_A \frac{dK_B}{dt_B}}{K^2} \right) + F_1 \frac{K_A}{K} \frac{dK}{dt_B} \right] \quad (18)$$

From (18), it follows directly that;

Proposition 2 *The effect of an increase in t_B on tax revenue in country A is ambiguous.*

¹⁸The derivation of this is similar to the derivation for the Separate Accounting case which is reported in the Appendix.

Qualitatively, the result is the same as under SA. The reason for the ambiguity, however, differs. Formula (18) contains two effects. The first is the direct fiscal externality on A 's tax base from a change in t_B . This effect is positive. The reason is that under FA - in contrast to the case of SA - the MNEs cannot use the transfer price as a profit shifting device (see (13)). Instead, an increase in t_B will induce a relocation of capital to the country with the lower tax rate (i.e., country A). However, the tax increase also makes it less attractive to invest in capital in general. Hence, the global capital stock falls and thus also the tax base in country A . Depending on which of the two effects dominates, the cross-effect on tax revenue may be positive or negative. We can therefore conclude that, contrary to what many analysts seem to believe, corporate taxation under FA will impose externalities on other countries in a situation with multinational enterprises using common inputs, but the externalities may on net be either negative or positive.

4.1.1 The Cobb-Douglas example

Using the same Cobb-Douglas function as before, the expression in (18) becomes

$$\frac{\partial V_A}{\partial t_B} = 2t_A \frac{F(1-\beta)}{2(1-t)} \frac{(1-\beta)\gamma - \alpha^2(1-\alpha)}{\alpha(1-\alpha)\gamma}$$

Again we note that the smaller is the remuneration of the hidden factor (γ), the more flexible is capital employment. A very small γ produces a large negative revenue externality. A positive externality is also possible, however; this requires a large factor share of the suppressed factor as compared to the factor share of capital. This situation is tantamount to a large pure profit or rent in production. A tax increase in country B results in a higher share of the MNEs' taxable income being assigned to country A via the relatively large decline in the capital stock of the entity in B . This higher share implies a sharp increase in tax revenue, if there are lots of profits from production. Finally, if the factor share of the common input is small, then the revenue externality will be positive (and small).

To conclude, our discussion so far has shown that tax rates may be set too low or too high even when FA is employed. The crucial issues are now: which system, SA or FA, entails the stronger externalities associated with corporate taxation, and

will noncooperative taxes under FA be higher or lower than those under SA? These issues are confronted in the next section.

5 Comparisons of SA and FA

We compare first the effects of increases in tax rates (from the same level) on capital stocks at home and abroad under SA and FA. It is easily seen from (8) and (16) that:

$$\left. \frac{dK_i}{dt_i} \right|_{FA} < \left. \frac{dK_i}{dt_i} \right|_{SA} < \left. \frac{dK_i}{dt_j} \right|_{SA} < \left. \frac{dK_i}{dt_j} \right|_{FA} \quad (19)$$

Hence, FA implies a more drastic cut in the capital stock in the country undertaking a tax increase than does SA. On the other hand, the cross-effect on capital in the other country is milder under FA (and may, in fact, be positive under circumstances noted above). As we have noticed already from formulas (8) and (16), the effect of a tax increase in either country on the use of the public input is the same under SA and FA. We therefore turn to a comparison of the cross-effects on tax revenue.

From (10) and (18), and using (8) and (16), we can derive

$$\left. \frac{dV_A}{dt_B} \right|_{FA} - \left. \frac{\partial V_A}{\partial t_B} \right|_{SA} = 2t \left[\frac{F_1^2 - \left(\frac{2F-S}{K} \right)^2}{2(1-t)F_{11}} - \frac{S}{(z-x)t\Phi''} \right] \quad (20)$$

The difference between the cross-effects on tax revenue under the two international tax regimes is determined by, apart from the (common) tax rate, the two terms in the parenthesis. The first term is positive, as both numerator¹⁹ and denominator are negative, and represents the relative cost of distorting capital investment under FA compared to SA in response to a marginal change in the tax rate in one country. This term is greater, the greater are pure profits associated with production by the MNE. The second term is negative, and it is numerically smaller the more significant are costs associated with exploiting transfer pricing.

¹⁹Remember that $(2F - S)/K - F_1 > 0$ can be interpreted as the overall remuneration of suppressed production factors of the MNE in the two countries (relative to the stock of capital).

Denoting the sum of tax revenues in the two countries by V , that is, $V = V_A + V_B$, it is easy to see that

$$\left. \frac{dV}{dt_i} \right|_{SA} = \left. \frac{dV}{dt_i} \right|_{FA} \quad (21)$$

In other words, starting from the same uniform level of taxation, an increase in the tax of either country will yield the same effect on total tax revenue in the two countries under SA and FA. So only the division of revenue changes differs between the two regimes. From this we conclude that

$$\left. \frac{dV_A}{dt_B} \right|_{FA} - \left. \frac{dV_A}{dt_B} \right|_{SA} < 0 \quad \text{if and only if} \quad \left. \frac{dV_A}{dt_A} \right|_{FA} - \left. \frac{dV_A}{dt_A} \right|_{SA} > 0$$

(again, for the same levels of taxes under the two regimes). Thus, we have:

Proposition 3 *At a given and uniform level of taxation in the two countries, the cross-effect (own-effect) on tax revenue from a unilateral tax increase will be smaller (larger) under Formula Apportionment than under Separate Accounting, if and only if*

$$\frac{F_1^2 - \left(\frac{2F-S}{K}\right)^2}{2(1-t)F_{11}} < \frac{S}{(z-x)t\Phi''} \quad (22)$$

In words, the requirement is that there are only moderate pure profits (a low relative remuneration of any hidden third factor of production), and that there are only insignificant costs associated with exploiting transfer pricing. It is intuitive that small transfer pricing costs lead to relatively small effects on own tax revenue under separate accounting, because here a tax increase implies a relatively drastic cut in the tax base. Small pure profits also imply that the decrease in the share assigned to the country raising its tax under FA will be only modest.

It follows from (22) that if the two tax principles were put on an equal footing, in the sense that the problem of transfer pricing also vanished under SA (i.e., $(z-x)t\Phi''$ approaches infinity), then a tax increase by country B will increase tax revenue in country A by more under FA than SA. Put differently, in the absence of transfer pricing, a unilateral tax increase creates a larger positive externality under FA than SA.²⁰

²⁰A similar point is also made by Keen (1999).

To make this point clearer, equation (22) can be rewritten for the case of the Cobb-Douglas example of the previous sections as follows:

$$\left. \frac{dV_A}{dt_B} \right|_{FA} - \left. \frac{dV_A}{dt_B} \right|_{SA} = 2tF \left[\frac{(1 + \alpha - \beta)\gamma}{2(1 - t)(1 - \alpha)\alpha} - \frac{2\beta}{(z - x)t\Phi''} \right] \quad (23)$$

Very low marginal transfer pricing costs (i.e. very low $(z - x)t\Phi''$) definitely produce a greater revenue externality under SA, due to a large loss of tax base via the MNE's transfer pricing. Conversely, a very high $(z - x)t\Phi''$ eliminates transfer pricing as a threat and ensures that the larger revenue externality occurs under FA instead. Equation (23) also shows when FA leads to the lowest revenue externality. This occurs when γ is very low (i.e., a virtual absence of rents, and thus also little incentive to move rents in response to tax changes). Finally, we may recapitulate that if the common input disappears, there no longer is any revenue externality under SA, whereas there still is a positive externality under FA.

Starting from zero taxes both countries enjoy positive increments in tax revenue from marginally raising their tax rates. In order to maximize tax revenue they move up the tax rate, until the marginal increase in revenue from doing so becomes equal to zero. If at the rate of tax, where tax revenue is maximized under SA, it holds true that the own effect on revenue of a tax increase is smaller under SA than under FA, then we can conclude that the non-cooperative level of taxation under SA will be less than the non-cooperative level of taxation under FA. We state this observation as

Proposition 4 *The non-cooperative level of taxation under FA will exceed that under SA, if and only if (22) holds.*

To reiterate, this happens if it is not very costly for the MNE to engage in transfer pricing (so that the threat of transfer pricing is a major consideration for tax authorities under SA), and if the pure profits resulting from production are modest.

Can anything be said about which international tax regime is preferable, and when? To answer this question it is not sufficient to simply ascertain which of SA and FA leads to the higher level of tax in the non-cooperative equilibrium. Instead

we need to know which of the two regimes leads to the higher tax revenue in the two countries (tax revenue maximization being the objective). In our simple symmetric set up, tax revenue as a function of the common tax level is bound to be a well-behaved concave function. On the basis of the level of tax under SA and FA, and the relative size of cross-effects on revenue, we can reveal some instances, in which the SA scheme will dominate the FA scheme (or vice versa). Close inspection of (10), (18), and (20) enables the following proposition:

Proposition 5 *Starting from a non-cooperative tax equilibrium under Separate Accounting, sufficient conditions for a move to Formula Apportionment to lower tax revenue in both countries are either*

$$\left[\frac{F_1^2 - \left(\frac{2F-S}{K}\right)^2}{2(1-t)F_{11}} < \frac{S}{(z-x)t\Phi''} \leq \frac{F_1^2 F_{12}^2}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \right]$$

or the same set of inequalities with the inequality signs reversed.

Proof. Using formulas (10), (18), and (20) we see that the two sets of inequalities in the Proposition are the conditions for

$$\left. \frac{dV_A}{dt_B} \right|_{FA} < \left. \frac{dV_A}{dt_B} \right|_{SA} \leq 0$$

respectively

$$\left. \frac{dV_A}{dt_B} \right|_{FA} > \left. \frac{dV_A}{dt_B} \right|_{SA} \geq 0$$

Given that all terms are valued in the non-cooperative tax equilibrium under SA we deduce that these two sets of inequalities correspond to

$$t^* \leq t^{SA} < t^{FA}$$

respectively

$$t^* \geq t^{SA} > t^{FA}$$

where t^* is the cooperative level of corporate income tax (common to either tax regime), and t^{SA}, t^{FA} are the non-cooperative tax levels in the two tax regimes.

Due to the concavity of the tax revenue function it is clear that in these two circumstances a move from SA to FA must produce tax rates even further away from the cooperative level and so reduce tax revenue in both countries.²¹ ■

The sufficient conditions for revenue reduction in the Proposition imply intermediary values for the marginal cost of exploiting transfer pricing on the part of the MNE. Furthermore, a combination of very moderate pure profits and very cooperative production factors (capital and common inputs), or the opposite combination of significant pure profits and very uncooperative factors of production is required. In accordance with intuition, cases with rather low costs associated with transfer pricing are not covered by the Proposition, since in these cases SA would be expected to entail rather low non-cooperative levels of tax and significant revenue increases upon introduction of FA.

We may once more recall the Cobb-Douglas example from section 3. For that example, the double inequality in Proposition 5 becomes equivalent to

$$\frac{4(1-t)\alpha(1-\alpha)\beta}{(1+\alpha-\beta)\gamma} > (z-x)t\Phi'' \geq \frac{4(1-t)(1-\alpha)\gamma}{\alpha^2}, \quad (24)$$

(and the same set of inequalities with the inequality signs reversed). In words, a combination of very low rents (small γ) plus intermediate marginal transfer pricing costs ($(z-x)t\Phi''$), or a combination of rather large profits and, again, intermediate costs of transfer pricing, will guarantee that a switch from SA to FA will not be desirable.

Logically, there will also be other circumstances in which a switch from SA to FA will be unwarranted. These circumstances have the non-cooperative taxes under SA and FA on either side of the cooperative level, with the taxes under SA closer (in terms of revenue/welfare deviations) to the optimal levels than the FA taxes.

²¹The reason for having two sets of inequalities in the proposition is that tax revenue spillovers can be either negative or positive. In the first case, negative revenue externalities, $\left. \frac{dV_A}{dt_B} \right|_{FA} < \left. \frac{dV_A}{dt_B} \right|_{SA} \leq 0$, imply that the cooperative solution lies below the non-cooperative one, $t^* \leq t^{SA} < t^{FA}$. In the latter case, positive revenue externalities entail that the cooperative solution exceeds the non-cooperative one, $t^* \geq t^{SA} > t^{FA}$.

6 Welfare maximization as the objective

We now assume that the authorities of the two countries in the model aim at maximizing welfare in lieu of solely maximizing tax revenue. As this section shows, provided that MNE's are owned in a balanced fashion between the two countries, we are able to derive results that are completely equivalent to the ones in the previous sections.

The country A -based MNE is now assumed to be owned in proportions $a : (1 - a)$ in the two countries, that is, the fraction a of the shares in the MNE is possessed by individuals living in country A . Vice versa, the B -based MNE is owned in the proportions $(1 - a) : a$ in the two countries. The welfare – or social surplus – measure is written as the sum of tax revenue, weighted by a (fixed) marginal cost of public funds (MCPF), denoted by λ , and the part of MNE net profits accruing to domestic residents. We shall assume that λ takes on the same value in both countries. Since the price of the MNEs' output is simply constant, there is no need to incorporate consumers surplus in the welfare measure.

It should be pointed out that welfare maximization in this section does not take into account any secondary effects on the economy from increased capital investment (increased capital investment, say, may spawn growth in other sectors). Accounting for such effects would necessitate a different model (e.g. a model with back- or forward linkages). In the present model, we have used the standard tax competition model to shed light on a novel issue, viz. the shift from SA to FA. Including such secondary effects, however, should not lead to results in conflict with those in the present framework.

6.1 Separate Accounting

Consider separate accounting first. Based on the definition of the social surplus given above, we have:

$$W_A = \lambda V_A + a\Pi^{SA} + (1 - a)\pi^{SA}$$

where V_A and Π^{SA}, π^{SA} are defined in section 3 (π^{SA} is the B -based MNE's after-tax profits). We are especially interested in the cross-effect on welfare, i.e. the effect of a tax increase in country B on social surplus in country A . Making use of the envelope theorem, we get

$$\frac{dW_A}{dt_B} = 2\lambda t_A \left[F_1^A \frac{dK_A}{dt_B} + S \frac{dG}{dt_B} \right] - a[F^B - GS] - (1-a)[f^B + (g-1)s] \quad (25)$$

In (25), an increase in t_B has two opposite effects on the tax revenue in country A . The capital stock in A is reduced, and that takes the tax base and tax revenue in the same direction. On the other hand, the transfer price G is raised, increasing tax revenue. The tax base of country A may therefore go up or down depending on the relative magnitudes of these two effects. In addition, the tax increase lowers after-tax profits on the part of the MNEs, and to the extent that the companies are owned by country A 's residents, this reduces social surplus. The latter third effect is new compared to the preceding analysis, and in isolation it decreases the chance of a positive spillover on the relevant objective function in country A .

6.2 Formula Apportionment

Under FA, social surplus a fortiori is measured as

$$W_A = \lambda V_A + a\Pi^{FA} + (1-a)\pi^{FA}$$

where now the definitions of V_A and Π^{FA}, π^{FA} are provided in section 4.

Defining T and τ the average effective tax rates for the two MNEs, and by making heavy use of the envelope theorem we obtain

$$\begin{aligned} \frac{dW_A}{dt_B} = 2\lambda t_A \left[(F^A + F^B - S) \frac{K_B \frac{\partial K_A}{\partial t_B} + K_A \frac{\partial K_B}{\partial t_B}}{K^2} + F_1 \frac{K_A}{K} \frac{\partial K}{\partial t_B} \right] \\ - a(F^A + F^B - S) \frac{\partial T}{\partial t_B} - (1-a)(f^A + f^B - s) \frac{\partial \tau}{\partial t_B}. \end{aligned} \quad (26)$$

As explained previously, the cross-effect on tax revenue under FA is of ambiguous sign, as it consists of a positive and a negative effect. In addition, the tax in country B increases the MNEs' effective average tax and thereby lowers after-tax profit income received by shareholders in country A .

6.3 Comparison of SA and FA

As tax policy in the two countries now has multiple aims, viz. obtaining tax revenue and securing MNE profits for domestic citizens, the two countries will not choose the same tax rate, unless they balance these two aims in the same way. For this to occur the MNEs under consideration must be symmetrically owned in the two countries.²² We shall in fact assume that $a = 1/2$. This assumption and identical tax rates at the outset simplifies the two expressions for social surplus changes above and renders a comparison between the two particularly simple. In fact, we easily establish

$$\left. \frac{dW_A}{dt_B} \right|_{SA} > \left. \frac{dW_A}{dt_B} \right|_{FA} \quad \text{iff} \quad \left. \frac{dV_A}{dt_B} \right|_{SA} > \left. \frac{dV_A}{dt_B} \right|_{FA} \quad (27)$$

Therefore, all our results in section 5 as to when the cross effects (on revenue there, on welfare here) under SA are higher than those under FA, etc., go through here with no modifications. Full symmetry and balanced ownership is accordingly required for the results for the relative size of tax spillovers to be equivalent under revenue maximization and under maximization of welfare.²³

7 Conclusions

With the spreading and increasing economic importance of multinational enterprises (MNEs), and the well documented use of transfer pricing, the viability of today's corporate income tax system as relying on Separate Accounting (SA) has come under pressure. Analysts, as well as the European Commission, are looking for an alternative system of taxation which will limit the vulnerability of the corporate tax system to MNEs' movement of surpluses from high tax to low tax countries, without introducing other serious problems.

²²If, say, the MNEs were primarily owned in country A , this asymmetry would be reflected in country B choosing a greater optimal rate of tax than country A , because it would attach a smaller weight to profit flows and a higher relative weight to tax revenues.

²³If common inputs flowed between entities of a MNE to the same extent, or if tax authorities recognize the true price of common inputs as $1/2$ on the basis that the inputs would be equally used by MNE entities, then a could be allowed to take on any value between 0 and 1.

One such candidate is the Formula Apportionment system as currently practiced in, e.g., Canada and the US. The central idea of the FA is to assign, using a formula based on the relative activity of the firm, a share of a MNE's overall surplus to each single jurisdiction, after which that jurisdiction can apply its own rate of tax to that income share. Thus, instead of having a system where taxation is based on *reported profits*, we could have a system where taxation is based on *reported activity*. Clearly, the fact that activity is much less prone (to say the least) to mis-reportings compared to profits makes Formula Apportionment an attractive alternative taxing system. On the other hand, Formula Apportionment indirectly introduces taxes on factors of production (as Gordon and Wilson, 1986, have shown) which distorts the allocation of resources. Thus, the introduction of Formula Apportionment is definitely not a panacea to the extensive transfer pricing problem of the current Separate Accounting system.

In this paper we have given certain aspects of SA and FA a closer look. Specifically, we have studied the fiscal externalities operating under these tax systems, and examined whether a shift from SA to FA could lead to higher non-cooperative taxes and to higher welfare. We employed a symmetric model of two countries and MNEs which operated entities in either country. Having characterized how the MNEs' capital stock and use of a common input depended on corporate tax rates in the two countries, we looked at the cross-effects of a tax hike in one country on tax revenue (or welfare) in the other. Comparing these under SA and FA we were finally able to conclude: If the pure profits harvested by the MNE are either very low or very high, and if the costs on the part of the MNE of engaging in transfer pricing are of intermediate size, then a switch from SA to FA will for sure *lower* tax revenue (welfare) in the two countries. There are additional circumstances in which the switch will likewise be undesirable, but these are harder to identify, since non-cooperative taxes will be too low under one regime and too high under the other. Finally, of course, there are also conditions, under which FA will be preferable to SA.

From a policymaker's point of view, the choice of tax system then relies on an assessment of the magnitudes of (a) the costs for MNEs of engaging in transfer pricing; and (b) the MNE pure profits. Indications of the size of costs of transfer pricing

can be found in the literature. Transfer pricing is relatively easy for tax authorities to prevent if the markets for the goods or assets sold are well functioning. In this case there exist market prices for similar products that can be used to establish true arm's length prices on intra-firm transactions. However, with MNEs the assets transferred are often highly specialized or intangible in nature (like technological know-how). In such cases, accurate information on the true value of the good will be exceedingly difficult to find, and MNEs may have considerable discretion in setting their transfer price. In such cases one would expect transfer pricing costs to be low or of intermediate size. Further evidence on the costs of transfer pricing can be found by considering the amount of tax-motivated transfer pricing undertaken. There is substantial evidence of such behavior, and surveys of the literature are provided by Gresik (2001) and Hines (1999). To sum up, it is quite realistic to think of the costs of engaging in transfer pricing as low or of intermediate size.

The second condition needed to make a case for not departing with the SA principle is that pure profits harvested by MNEs are either very low or very high. The question is how large is the return to the fixed factor, that is in real life how large is the return to MNE firm-specific assets related to technology know-how, marketing etc. This is by no means an easy question to answer and will depend on a concrete assessment of industries. If the return to such MNE-specific assets are only of intermediate size, there is no clear case for either tax system from the perspective of spillover effects from taxation.

Concluding we would like to emphasize that our analysis should be seen as a step towards better understanding of the consequences of a possible shift in the system of international corporate taxation. Our results point to some factors of relevance for political decisions and provide directions for empirical analysis to back up these decisions. Needless to say, our analysis has in a sense focused on 'average' or 'typical' tax spillovers between countries applying either SA or FA, making heavy use of symmetry assumptions. Some of the gravest problems associated with SA, however, surely pertain to asymmetry, i.e. situations in which some countries would prefer to be able to set rather high corporate taxes compared to other countries and therefore find themselves especially vulnerable to MNE transfer pricing. It will

certainly be interesting (but also very complicated, according to our preliminary attempts) to examine the relative working of SA and FA in such asymmetric set ups. For now, we shall have to leave this for future research.

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Appendix

Dervivation of the first order condition (10)

To prove (10), differentiate tax revenues in country A with respect to the tax in country B to get:

$$\frac{dV_A}{dt_B} = t_A \left[F_1 \frac{dK_A}{dt_B} + F_2 \frac{dS}{dt_B} + (G - 1) \frac{dS}{dt_B} + S \frac{dG}{dt_B} + f_1 \frac{dk_A}{dt_B} + f_2 \frac{ds}{dt_B} - g \frac{ds}{dt_B} - s \frac{dg}{dt_B} \right] - \frac{d(xt_A(\Phi S + \phi s))}{dt_B}.$$

Symmetry implies that $S = s, G = g = 1, K_A = k_A, S = s, F_1 = f_1, F_2 = f_2$, and $\Phi = \phi = \Phi' = \phi' = 0$. On the basis of that, the second term above becomes zero and the remaining term can be re-written as:

$$\frac{dV_A}{dt_B} = t_A \left[2F_1 \frac{dK_A}{dt_B} + 2S \frac{dG}{dt_B} + (F_2 + f_2 - 1) \frac{dS}{dt_B} \right],$$

where we have made use of the fact that $\frac{dG}{dt_B} = -\frac{dg}{dt_B}$. Since the third term equals zero at equilibrium, the above equation reduces to equation (10) in the text.

The cost of Transfer pricing abuse

In this part of the appendix we explore a different type of transfer pricing costs in the form of resource costs. These costs may be interpreted as efforts to conceal the transfer pricing activity from national tax authorities, covering e.g. lawyers' and accountants' salaries, and as such they represent a pure waste of resources in the model.

1. Exogenous recourse cost: $H(G - 1)$

We start from the simplest possible cost, namely a resource cost $H(G - 1)$ which is assumed to be a convex function, where $H(0) = H'(0) = 0, H > 0$ (for $G \neq 1$) and $H'' > 0$.²⁴ Thus, if the price deviates from the true price of 1, firm A incurs costs which are an increasing function of the deviation from the true price.

After tax profits are then equal to:

²⁴This formulation was used in Kant (1988) and in Hauffer and Schjelderup (2000).

$$\begin{aligned}\Pi^{SA} &= (1 - t_A) [F(K_A, S) + (G - 1)S] \\ &\quad + (1 - t_B) [F(K_B, S) - GS] - RK - H(G - 1)\end{aligned}$$

First order conditions become:

1. G: $(t_B - t_A)S = H'$,
2. K_i : $(1 - t_i)F_1^i - R = 0$,
3. S: $(1 - t_A)F_2^A + (1 - t_B)F_2^B = 1 - t_A - G(t_B - t_A)$.

Totally differentiating the first order condition for G gives:

$$dG = -\frac{S}{H''}dt_A + \frac{S}{H''}dt_B + \frac{t_B - t_A}{H''}dS$$

Thus, a change in a country's tax will have a direct effect and an indirect effect on the transfer price. For equal initial taxes, we get the same qualitative results as in the paper, i.e. only the direct effect mentioned above matters.

It can easily be shown that at this equal tax situation, the responses of the optimal choices of K_i and S to tax changes deliver the same formula for the response to tax rates as in (8), and (9) in the paper.

2. Transaction volume matters proportionally: $SH(G - 1)$ or $H(S(G - 1))$.

In the first formulation ($SH(G - 1)$) the cost of transfer pricing abuse is rendered proportional to the size of the shipment between the two entities. The second formulation ($H(S(G - 1))$) normalizes the cost of transfer pricing abuse by the size of the shipment between the two entities of the MNE. In both cases the first order conditions are:

1. G: $t_B - t_A = H'$
2. K_i : $(1 - t_i)F_1^i - R = 0$,
3. S: $(1 - t_A)F_2^A + (1 - t_B)F_2^B = 1 - t_A - G(t_B - t_A) + (G - 1)H'$.

Totally differentiating the FOC wrt. G and focusing on $\frac{dG}{dt_A}$ gives:

$$\frac{dG}{dt_A} = \frac{1}{SH''} - (G - 1) \frac{dS}{dt_A}$$

Since H'' is positive, the first term in the expression is negative. An increase in country A's tax directly leads to a lowering of the transfer price G so as to shift profits out of that country. The second term has its sign depending on whether the transfer price is below or above one (note that $\frac{dS}{dt_A} < 0$). If it is below, then the term is negative, and vice versa. If G is below one, it must be because country B is the low tax country. If t_A is raised further, then as a direct effect, G is reduced even more. As an indirect effect, any tax increase lowers the use of the input S , and that in itself causes the cost of transfer pricing abuse to decline, allowing a further deviation of G from one. In the situation sketched, the direct and the indirect effect on the transfer price go together. In the mirror image situation of G greater than one, the indirect effect would be positive, taking G even further away from one, hence working against the negative direct effect. Similarly, the effect of a change in country B's tax on the transfer price consists of a positive direct effect and a negative (positive) indirect effect, if, to begin with, country B is the low- (high-) tax country.

However, starting from a situation of equal tax rates, the indirect effect will simply be zero (both H' and $G - 1$ will be equal to zero).

It can be shown that at this equal tax situation, the responses of the optimal choices of K_i and S to tax changes deliver the same formula for the response to tax rates as in (8), and (9) in the paper.

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