Tax Spillovers under Separate Accounting and Formula Apportionment¤

Søren Bo Nielsen, Pascalis Raimondos-Møller

Copenhagen Business School, EPRU, CEPR and CESifö

Guttorm Schjelderup

Norwegian School of Economics and Business Administration and CESifö

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Abstract

It is observed in the real world that taxes matter for location decisions and that multinationals shift pro…ts by transfer pricing. The US and Canada use 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 on how changes in tax rates a¤ect capital formation, input choice, and transfer pricing as well as 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 identi…ed in the paper, actually aggravate them.

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1 Introduction

Perhaps the most stunning feature of the world economy in the last decade is the rapid growth in foreign direct investments (FDI). During the period 1990-1997 FDI grew by approximately 20 per cent per year, and in 1997 foreign a¢liate exports was one-third of world exports. Furthermore, GDP attributed to foreign a¢liates accounted in 1997 for 7 per cent of global GDP, and sales of foreign a¢liates have during the nineties grown faster than world exports of goods and services.[1]

A second trend in the globalization process pertains to the new evidence of tax competition and problems related to tax exportation.[2] Devereux and Gri¢th (1998) …nd that e¤ective marginal tax rates play an important role in the choice of location. In a study that encompasses 10 of the major OECD countries Chennels and Gri¢th (1997) …nd that statutory corporate tax rates have fallen in seven countries and risen in three the last decade.[3] On average, excluding Ireland, the rate has fallen from 48 per cent to just over 40 percent. At the same time withholding taxes on repatriated dividend income have fallen from 10 to 6.6 per cent on average, while on interest income they have fallen from 10 to 8 percent. By tax exportation is meant the possible negative e¤ects on economic activity and, therefore, the tax base in other countries resulting from a given country raising its corporate income tax. Like the issues more intimately related to MNEs, concerns about tax exportation also center on tax spillovers of national corporate income taxation in the international economy.

The increased importance of FDI and the fear of tax competition and tax exportation has made tax practitioners, politicians, and economists to worry about the e¤ectiveness of national corporate income taxation in a situation where MNEs can move activities as well as their earnings between countries. At the heart of the matter is the fear that low-tax countries may attract more than the lion's share of mobile tax bases.

[1] World Investment Report 1998.

[2] For a survey of the empirical literature on tax exportation see e.g. Mintz (1999).

[3] The countries are Australia, Canada, France, Germany, UK, Ireland, Italy, Japan, Spain, and the US.

The concerns voiced are not unfounded. Substantial evidence is now emerging that documents pro…t shifting by transfer pricing.[4] Grubert and Mutti (1991) and Hines and Rice (1994) …nd strong indirect evidence for transfer pricing in that high taxes reduce the reported pro…tability of U.S. a¢liates in foreign locations. Harris et.al. (1993) report that U.S. tax liabilities of American …rms with a¢liates in tax havens are signi…cantly lower than those of comparable American …rms over the 1984-1988 period. Recently, Collins, Kemsley and Lang (1998) study a pooled sample of U.S. multinationals and …nd that 'normalized' reported foreign pro…tability exceeds U.S. pro…tability among …rms facing foreign tax rates below the U.S. rates. The evidence of transfer pricing is also present in Europe. Weichenrieder (1996), for example, …nds that German …rms have shifted pro…ts to the low tax "zone" in Ireland.

Today's system of corporate income taxation in the world is best characterized by the principle of Separate Accounting (SA). Each individual country computes the income generated by …rms located within its jurisdiction (which can be entities of MNEs) and subsequently applies the national tax rate to it. Besides the inherent problems of some countries attempting to attract MNE activity and pro…ts by o¤ering lenient tax treatment, a further problem is that national de…nitions of tax bases are not compatible, with the consequence that certain income items may undergo taxation in more than one country. This is the international double taxation problem.

A number of analysts have suggested that one way to avoid these problems may be to switch from the system of Separate Accounting to one of Formula Apportionment (FA).[5] Under FA, each country aims at delimiting that part of a MNE's global income which is taxable in its jurisdiction. The instrument for accomplishing this is a formula, containing relative activity measures weighted together. The relative activity measures may include the MNE's relative capital stock, relative sales, and relative payroll in the country.[6]

[4] For a survey of the empirical literature see Hines (1999).

[5] Advocates for such a transition are among others Musgrave (1973), Bird and Brean (1986), McLure (1989), Bucks and Mazerov (1993) and more recently Shackelford and Slemrod (1998).

[6] Both the US and Canada apply Formula Apportionment to the taxation of national …rms. For

With this FA system, it is evident that if a MNE moves pro…ts from one country to another by means of manipulation of transfer prices, this will not in itself lead to a change in the tax base of any single country, whence FA seems to be immune to MNE income shifting activity. Furthermore, if all countries agree on a common de…nition of MNE taxable income and subsequently apply identical formulas to determine their share of this income, double taxation of MNE income should be obviated.

While the international tax literature contains numerous studies of the implications of the existing system of corporate income taxation (SA), the alternative Formula Apportionment system has not been analyzed in much detail. Only a few studies exist which examine the mechanics and economic consequences of taxation according to FA. McLure (1980) …rst demonstated that formula apportionment transforms the state corporate income tax into three separate taxes on the factors in the apportionment formula. This clearly induces state authorities to modify the weights used in the formula in order to stimulate employment and investment in their own state.[7] Gordon and Wilson (1986) show that FA may seriously distort producer prices if national tax bases are not harmonized internationally. They …nd, for example, that if allocation is mainly tied to capital formation (or property), price distortions will di¤er among …rms, creating incentives for mergers. When allocation is based on payroll taxes they …nd opposite incentives in that mergers among …rms producing di¤erent 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, it is shown that in equilibrium nations will choose ine¢ciently low tax rates. This latter result is analysed in detail in a recent paper by Anand and Sansing (2000). They show that while the harmonised apportionment rule will prevail as the cooperative solution of a game between two states, a state can increase its welfare by deviating from this cooperative solution, i.e. a typical

an extensive outline of the FA system and its workings in the US see Weiner (1998).

[7] Goolsbee 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.

Prisoner's Dilemma situation.

This paper di¤ers from those above in that it studies some other properties of SA and FA as well as carrying out a comparison of the two systems. Speci…cally, we examine how MNE activity is a¤ected under taxation according to SA and FA, and what kind of spillovers between countries are present under the two systems. Our analysis is carried out using a model of two countries embedded in a larger world economy. The model portrays MNEs with a parent …rm in one country and a subsidiary in the other. These MNEs produce an output using a public input and (plant-speci…c) capital. The public 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 e¤ects of corporate income tax increases on the choice of capital and public inputs, as well as on transfer pricing. Of special interest is how an increase in the corporate tax in one country a¤ects capital stocks on the part of …rms in the other country. This information is then used to derive how the tax increase a¤ects 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 world economy. We investigate these issues in a situation in which the two countries can agree on the international tax principle, i.e. SA or FA, but set their tax rates noncooperatively.

Our main results are the following: While under SA an increase in the rate of tax in one country triggers a reduction in the capital stocks of MNEs in both countries, under FA the cross-e¤ect on capital in other countries may be positive. Furthermore, under both international tax schemes, the cross-e¤ect on tax revenue of a tax increase in one country is of ambiguous sign. Closer investigation reveals 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 pro…t the MNEs generate. The same considerations 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.

We …rst prove these results for the case where tax authorities in the two countries simply maximize tax revenue. Subsequently we show that, provided there is a balanced ownership of MNEs in the two countries, exactly the same results obtain if the authorities instead maximize welfare.

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 as applied in the taxation of the MNE 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 tax revenue maximization and welfare 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 …rm 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 …rm which has its headquarters in country A(B) (to be called …rm A and B, respectively). Both MNEs produce a single good in each location using capital $(K;k)$ and a public input $(S;s)$. The price of the …nal good as well as the public input is normalized to unity.[8] The input is public in the sense that the parent …rm's use of it does not diminish its use by the a¢liate, and vice versa.[9] The parent …rm charges its a¢liate a fee of $(G;g)$ per unit of the public input. Since the production structure of each a¢liate of a MNE is assumed to be the same, and since the public input is equally 'shared' between the parent …rm and the subsidiary (or equally useful in the two entities), the true price of the public input for each …rm can be thought of as being 1=2: The price charged by the parent, however, may for pro…t shifting purposes be above or below the true price of the input.

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

[9] Examples of public inputs could be headquarter services or management expertise.

Transfer pricing by the parent …rm involves a resource cost $H(G)$ which is assumed to be a convex function where

$$H\left(\frac{1}{2}\right) = H'\left(\frac{1}{2}\right) = 0;$$

$H' > 0$ (for $G > 1=2$) and $H'' > 0$:[10] Thus, if the price deviates from the true price of 1=2; …rm A incurs costs which are an increasing function of the deviation from the true price. These costs may be interpreted as e¤orts to conceal the transfer pricing activity from national tax authorities.[11] They represent pure waste of resources in the model, but we emphasize that allowing tax authorities to collect …nes instead would not alter our results in a qualitative way.

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

$$\pi_A = F(K_A; S) + (G - 1)S - RK_A - H(G):$$
$$\pi_B = F(K_B; S) - GS - RK_B:$$

Note that F represents the common production structure of the two entities, and that it is the headquarters which incur costs associated with distorting the transfer price (as long as these costs are not deductible from taxation, this is immaterial, though). If the governments in countries A and B tax this MNE, they can either do so by using separate accounting or formula apportionment. We start by looking at the implications of the former principle.[12]

3 Separate Accounting (SA)

Most countries use SA to determine pro…ts of a MNE. An a¢liate of a MNE is subject to taxation in the jurisdiction of location, if the a¢liate is a separate and

[10] Similarly for the parent …rm in country B; that is $h\left(\frac{1}{2}\right) = h'\left(\frac{1}{2}\right) = 0$; $h' > 0$ and $h'' > 0$:

[11] This assumption is standard in the literature on both tax evasion and transfer pricing (see e.g. Kant 1988, or Hau‡er and Schjelderup, 2000).

[12] Given the symmetric production structure of the two entities of the MNE headquartered in country A, it is su¢cient in the analysis to consider this MNE only. There is no need to bring in the B-MNE, except in the latter part of section 6.

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. In what follows we assume that the taxing authority cannot asses its true value.[13;14]

We define t_i to be the tax rate in country i ($i = A; B$), and assume that the rental price of capital and costs associated with transfer pricing are not deductible from tax.[15] Then global after-tax profits of the MNE are under SA

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

The assumption of lack of deductibility of transfer pricing costs can readily be altered without affecting the qualitative results to follow.

Given the intangible nature of the public good, 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 resource costs that accrue under transfer pricing. Thus, in the optimum the headquarters of the MNE balance the

[13] In 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 very 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.

[14] The two governments and the MNE are enganged in a two-stage game. At stage one the governments choose taxes 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.

[15] A 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).

marginal gains from profit shifting against the costs, yielding a first order condition for G as follows,

$$\frac{\partial \Pi^{SA}}{\partial G} = (t_B - t_A)S - H'(G) = 0; \quad \Leftrightarrow \quad (t_B - t_A)S = H'(G): \tag{2}$$

The first order condition in (2) is easily interpreted; it equates the tax savings of transfer pricing to the marginal transactions costs of transfer pricing. The public good will be underinvoiced, if $t_A > t_B$, and overinvoiced, if $t_A < t_B$; in either case the transfer price increases the costs in the high tax country and income in the low tax country. It is now straightforward to show from (2) that

$$\frac{\partial G}{\partial t_A} = -\frac{1}{H''} < 0; \quad \frac{\partial G}{\partial t_B} = \frac{1}{H''} > 0: \tag{3}$$

An increase in t_B raises the cost of accumulating profits in country B and induces the MNE to increase the costs of the importing affiliate in B by increasing the price of the input. If t_A goes up, it becomes more costly to overinvoice and the MNE now wants to accumulate profits in B by reducing the transfer price.

The first order conditions for the use of inputs are:

$$\frac{\partial \Pi^{SA}}{\partial K_i} = (1 - t_i)F_1^i - R = 0; \quad i = A, B; \tag{4}$$

$$\frac{\partial \Pi^{SA}}{\partial S} = \left[(1 - t_A)F_2^A + (1 - t_B)F_2^B\right] - [1 - t_A - G(t_B - t_A)] = 0; \tag{5}$$

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

The two first order conditions given by (4) have the usual interpretation of equating the after-tax marginal product of capital to the user cost of capital. Equation (5) equates the after-tax contribution of the public input to production (the first squared bracket) to the net of tax cost of using this input (the second squared bracket). The latter includes the costs and benefits of using the input for profit shifting purposes.[16]

Throughout the paper we will concentrate on the special case in which taxes initially are equal ($t_A = t_B = t$). The assumption of identical taxes simplifies formulas

[16] Note that on account of the convexity of the H function, the net cost of the public input lies above $1 - \max(t_A; t_B)$ and below $1 - (t_A + t_B)/2$.

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 (2)), the marginal productivity of capital will be equalized across countries, i.e. $F_1^A = F_1^B$ (see (4)), and the public input is used only to maximize global production, i.e. $F_2^A + F_2^B = 1$ (see (5)). Equal taxes (and a common production structure with a public 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) and (5) implies, together with symmetry, the following responses in capital stocks and inputs to changes in tax rates:

$$\begin{aligned} \frac{\partial K_i}{\partial t_i} &= \frac{F_1(2F_{22}F_{11} - F_{12}^2)}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\ \frac{\partial K_i}{\partial t_j} &= \frac{F_1F_{12}^2}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\ \frac{\partial S}{\partial t_i} &= \frac{F_1F_{12}}{2(1-t)(F_{22}F_{11} - F_{12}^2)} \end{aligned} \tag{6}$$

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 (6) that

$$\frac{\partial K_A}{\partial t_A} = \frac{\partial K_B}{\partial t_B} < \frac{\partial K_A}{\partial t_B} = \frac{\partial K_B}{\partial t_A} < 0; \quad \frac{\partial S}{\partial t_i} < 0; \quad i = A, B: \tag{7}$$

The inequalities in (7) 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 public 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 that lowers the stock of capital in that country. A reduced capital stock in country i decreases the marginal productivity of the public input S, the use of which therefore likewise

is reduced. Less use of the public input in production in country j reduces the marginal productivity of capital there, lowering the stock of capital employed.

Given the outline of the basic model and the comparative statics results, we are now in a position to examine how taxes a¤ect 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. As a …rst shot we assume that revenue maximization is the objective of the government. In section 6, however, the objective is alternatively taken to be maximization of welfare. We are able to demonstrate there that under conditions of balanced ownership of MNEs, equivalent results can be obtained.

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),

$$\frac{@V_A}{@t_B} = t_A \left[F_1 \frac{@K_A}{@t_B} + S \frac{@G}{@t_B} \right]; \tag{8}$$

where $V_A = t_A [F_A + (G - 1)S]$ is the tax revenue for country A: Having shown that $@K_A=@t_B < 0$ and $@G=@t_B > 0$, we may state:

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

An increase in t_B leads the MNE to raise its transfer price ($@G=@t_B > 0$, see (3)). This has the e¤ect of moving some pro…ts 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 $@K_A=@t_B$ is negative, see (7). It represents the e¤ect

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 public 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 …scal externality that pertains to the widening of the tax base will, other things being equal, lead to too low tax rates in the tax equilibrium since neither country takes this e¤ect into account. In contrast, overlooking the negative spillover e¤ect 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 e¤ects.

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.

Speci…cally, assume that the production function $F(:)$ is Cobb-Douglas and given by $F(K;S) = K^{®}S^{¯}D^{°}$, with $° = 1 ¡ ® ¡ ¯$. The term $D^{°}$ 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, location-speci…c management, etc.). In what follows we shall allude to the latter interpretation of the term.

With the Cobb-Douglas production structure, the expression in (8) becomes

$$\frac{@V_A}{@t_B} = {}^{¯}Ft\left[\frac{2}{H^{00}} ¡ \frac{®^2}{2(1 ¡ t)°(1 ¡ ®)}\right], \tag{9}$$

From (9) it is seen that the cross-e¤ect on revenue in country A from a tax increase in B becomes positive for a very low value of H^{00}. 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 H^{00} is very high, transfer pricing will not be used. But the tax increase will lower the use of the public 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 °, 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-e¤ect on revenue is proportional to the factor share of the public input ¯ (ignoring the sum constraint on ®; ¯ and °). Hence, the less important is the public 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 arises 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 e¤ects. This result is interesting since it di¤ers from the main …nding in the tax competition literature. In the standard tax competition model (see e.g. Zodrow and Mieszkowski (1986), or Wildasin (1988)), taxes are set too low in the tax equilibrium due to the positive externality that arises if one country increases its tax rate.

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 speci…c jurisdiction, FA may utilize information on the relative capital stock employed in that jurisdiction, the relative sales there, and the relative payroll there. For simplicity we here consider only a simple variant of FA, in which the capital stock is the sole factor entering the sharing formula in the FA.[17] We likewise assume that the

[17] Note, that after a suitable rede…nition of taxable income, the stock of capital can be interpreted as the stock of labor, in which case the FA formula e¤ectively employs payroll in the sharing formula. Moreover, observe 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).

FA arrangement makes use of the same de…nition in both countries for the multinational's global taxable income; the rates chosen in the two countries may in principle di¤er, though.

Under FA the before-tax pro…ts on the part of the two entities of the MNE are $¦_A + ¦_B$; 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. Tax liability, V_i; in either country is thus

$$V_i = t_i \frac{K_i}{K}[F(K_A; S) + F(K_B; S) ¡ S]: \tag{10}$$

After-tax pro…ts are accordingly given by

$$\begin{aligned} ¦^{FA} &= (¦_A + ¦_B) ¡ V_A ¡ V_B; \\ &= (1 ¡ t)[F(K_A; S) + F(K_B; S) ¡ S] ¡ RK ¡ H(G): \end{aligned} \tag{11}$$

where $t = \frac{K_A}{K} t_A + \frac{K_B}{K} t_B$ is the average e¤ective tax rate on the part of the MNE. Note that the transfer price set by the multinational has no bearing on the de…nition of the tax base for use in either country. Hence, in order to maximize after tax pro…ts, the MNE will wish to set G equal to its 'true' value of one half. Accordingly, in this model transfer pricing is not present under Formula Apportionment.

To …nd the MNE's choice of capital stocks and quantity of the public input we derive the …rst order conditions for maximization of after-tax pro…ts. In the following we focus on the case of initially identical rates of tax.[18] The conditions are:

$$\frac{@¦^{FA}}{@K_i} = (1 ¡ t) F_1^i ¡ [F(K_A; S) + F(K_B; S) ¡ S] \frac{K_j}{K^2}(t_i ¡ t_j) ¡ R = 0; \tag{12}$$

$$\frac{@¦^{FA}}{@S} = F_2^A + F_2^B ¡ 1 = 0 \tag{13}$$

The …rst order conditions in (12) for the choice of capital stocks are more complicated than under SA (compare with (4)), as they contain an extra term. A rise in, say,

[18] Again, 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 …rst stage are presented in subsection 4.1.

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 pro…ts. This e¤ect is captured by the second term on the right hand side of (12). The …rst order condition for S, on the contrary, is particularly simple here – the sum of marginal productivities has to equal unity. No extra term re‡ecting costs and bene…ts of transfer pricing (viz. (5)) appears.[19]

Totally di¤erentiating the …rst order conditions we derive formulas for how capital stocks and public input choice are a¤ected by tax changes (a fortiori assuming identical taxes at the outset),

$$\begin{aligned}
\frac{@K_i}{@t_i} &= \frac{F_1F_{22}F_{11} + (F_{22}F_{11} - F_{12}^2)(2F - S)/K}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\
\frac{@K_i}{@t_j} &= \frac{F_1F_{22}F_{11} - (F_{22}F_{11} - F_{12}^2)(2F - S)/K}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)} \\
\frac{@S}{@t_i} &= \frac{F_1F_{12}}{2(1-t)(F_{22}F_{11} - F_{12}^2)}
\end{aligned} \tag{14}$$

From (14) we can conclude that

$$0 > \frac{@K_A}{@t_A} = \frac{@K_B}{@t_B} < \frac{@K_A}{@t_B} = \frac{@K_B}{@t_A}; \quad \frac{@S}{@t_i} < 0; \quad i = A; B: \tag{15}$$

The inequalities in (15) relate that under SA, the e¤ect of a tax increase on the MNE's capital stock in the same country is negative. Di¤erent from under SA, the sign of the cross-e¤ect on capital employed in the other country is now ambiguous (cf. (6)). This is seen from (14) by examining the numerator of $@K_i/@t_j$: It can then be seen that the numerator may become negative if its second term dominates the …rst. This will happen if the renumeration 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 public inputs are, is small.

[19] Note that with equal taxes the values entering the …rst 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 di¤erent in the two cases.

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. 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, $@K_i=@t_j$ can be found to be proportional to the expression $[2° ¡ ®(1 ¡ ®)]$, which clearly has an ambiguous sign. Again, however, if the share of rents, °, is large, a positive cross-effect on capital is guaranteed.

From (5) and (14) we deduce that the effect of a tax increase in any country on the use of the public 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. In particular, the effect on tax revenue in A from a marginal change in t_B is,

$$\frac{@V_A}{@t_B} = [F(K_A;S) + F(K_B;S) ¡ S]t_A \left(\frac{K_B \frac{@K_A}{@t_B} ¡ K_A \frac{@K_B}{@t_B}}{K^2} \right) + t_A F_1 \frac{K_A}{K} \frac{@K}{@t_B}: \quad (16)$$

From (16), it follows directly that;

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

Qualitatively, the result is the same as under SA. The reason for the ambiguity, however, di¤ers. Formula (16) contains two e¤ects. The …rst is the direct …scal externality on A's tax base from a change in t_B: This e¤ect is positive. The reason is that under FA - in contrast to the case of SA - the MNE cannot use the transfer price as a pro…t shifting device (see (11)). 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 e¤ects dominates, the cross-e¤ect 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 public 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 (16) becomes

$$\frac{@V_A}{@t_B} = \frac{tF(1 ¡ \bar{\ })}{2(1 ¡ t)} \frac{(1 ¡ \bar{\ })° ¡ ®^2(1 ¡ ®)}{®(1 ¡ ®)°}$$

Again we note that the smaller is the renumeration to the hidden factor (°), the more ‡exible is capital employment. A very small ° 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 pro…t or rent in production. A tax increase in country B results in a higher share of the MNE's 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 pro…ts from production. Finally, if the factor share of the public input is small, then the revenue externality will be positive.

To conclude, then, 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 discussed in the next section.

5 Comparisons of SA and FA

We compare …rst the e¤ects 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 (6) and (14) that:

$$\left.\frac{@K_i}{@t_i}\right|_{FA} < \left.\frac{@K_i}{@t_i}\right|_{SA} < \left.\frac{@K_i}{@t_j}\right|_{SA} < \left.\frac{@K_i}{@t_j}\right|_{FA} \tag{17}$$

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-e¤ect 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 (6) and (14), the e¤ect 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-e¤ects on tax revenue.

From (9) and (16), and using (6) and (14), we can derive

$$\left.\frac{@V_A}{@t_B}\right|_{FA} - \left.\frac{@V_A}{@t_B}\right|_{SA} = t\left[\frac{F_1^2 - \frac{2F-S}{K}\phi_2}{2(1-t)F_{11}} - \frac{S}{H''}\right] \tag{18}$$

The di¤erence between the cross-e¤ects 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 …rst term is positive, as both numerator[20] and denominator are negative, and represents the relative cost of distorting capital investment under FA compared to SA in responce to a marginal change in the tax rate in one country. This term is greater, the greater are pure pro…ts associated with production by the MNE. The second term is negative, and it is numerically smaller the more signi…cant are costs associated with exploiting transfer pricing.

[20] Remember 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

$$\frac{@V}{@t_i}\Big|_{SA} = \frac{@V}{@t_i}\Big|_{FA} \tag{19}$$

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

$$\frac{@V_A}{@t_B}\Big|_{FA} - \frac{@V_A}{@t_B}\Big|_{SA} < 0 \quad \text{if and only if} \quad \frac{@V_A}{@t_A}\Big|_{FA} - \frac{@V_A}{@t_A}\Big|_{SA} > 0$$

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

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

$$\frac{F_1^2 - \left(\frac{2F - S}{K}\right)^2}{2(1 - t)F_{11}} < \frac{S}{H''} \tag{20}$$

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 low 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 (20) 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., H'' approaches infinity), 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.[21]

[21] A similar point is also made by Keen (1999).

To make this point clearer, equation (20) can be rewritten for the case of the Cobb-Douglas example of the previous sections as follows:

$$\frac{@V_A}{@t_B}\Big|_{FA} - \frac{@V_A}{@t_B}\Big|_{SA} = tF \cdot \frac{(1+\alpha-\bar{\alpha})\gamma}{2(1-t)(1-\alpha)\alpha} - \frac{2\bar{\alpha}}{H''}, \tag{21}$$

A very low H'' de…nitely produces a greater revenue externality under SA, due to a large loss of tax base via the MNE's transfer pricing. Conversely, a very high H'' eliminates transfer pricing as a threat and ensures that the larger revenue externality occurs under FA instead. Equation (21) 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 movements of rents in response to tax changes). Finally, we may recapitulate that if the public 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 e¤ect 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 (20) 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 pro…ts 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 su¢cient 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-e¤ects on revenue, we can reveal some instances, in which the SA scheme will dominate the FA scheme (or vice versa). Close inspection of (8), (16), and (18) enables the following proposition:

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

$$\frac{F_1^2 - \frac{2F_{12}S}{K}\phi_2}{2(1-t)F_{11}} < \frac{S}{H''} \cdot \frac{F_1^2 F_{12}^2}{2(1-t)F_{11}(F_{22}F_{11} - F_{12}^2)}$$

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

Proof. Using formulas (8), (16), and (18) we see that the two sets of inequalities in the Proposition are the conditions for

$$\left.\frac{\partial V_A}{\partial t_B}\right|_{FA} < \left.\frac{\partial V_A}{\partial t_B}\right|_{SA} \cdot 0$$

respectively

$$\left.\frac{\partial V_A}{\partial t_B}\right|_{FA} > \left.\frac{\partial V_A}{\partial t_B}\right|_{SA} \, , \, 0$$

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

$$t^{\alpha} \cdot t^{SA} < t^{FA}$$

respectively

$$t^{\alpha} \, , \, t^{SA} > t^{FA}$$

where t^{α} 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.[22] ■

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 public 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 one more time recall the Cobb-Douglas example from section 3. For that example, the double inequality in Proposition 5 becomes equivalent to

$$\frac{4(1-t)\theta(1-\theta)^{-}}{(1+\theta-^{-})^{\circ}} > H'' > \frac{4(1-t)(1-\theta)^{\circ}}{\theta^{2}}; \tag{22}$$

(and the same set of inequalities with the inequality signs reversed). In words, a combination of very low rents ($^{\circ}$) plus intermediate marginal transfer pricing costs (H''), 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 welfare deviations) to the optimal levels than the FA taxes.

[22] The 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, $\frac{\partial V_A}{\partial t_B}^{-}_{FA} < \frac{\partial V_A}{\partial t_B}^{-}_{SA} < 0$; imply that the cooperative solution lies below the non-cooperative one, $t^{\alpha} < t^{SA} < t^{FA}$: In the latter case, positive revenue externalities entail that the cooperative solution exceeds the non-cooperative one, $t^{\alpha} > t^{SA} > t^{FA}$.

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. The welfare – or social surplus – measure is the sum of tax revenue, weighted by a (…xed) marginal cost of public funds (MCPF), denoted by ½, and the part of MNE net pro…ts accruing to domestic residents. We shall assume that ½ takes on the same value in both countries. Since the price of the MNE's output is simply constant, there is no need to incorporate consumers surplus in the social surplus measure.

6.1 Separate Accounting

Consider separate accounting …rst. After-tax pro…ts of the MNE under SA are

$$¦^{SA} = (1 ¡ t_A)[F^A + (G ¡ 1)S] + (1 ¡ t_B)[F^B ¡ GS] ¡ RK ¡ H(G):$$

Here F^A is short for $F(K_A; S)$, and similarly for F^B. Tax revenue in country A is

$$V_A = t_A[F^A + (G ¡ 1)S];$$

and social surplus amounts to

$$W_A = ½V_A + a¦^{SA}:$$

First order conditions on the part of the MNE are unchanged. We are especially interested in the cross-e¤ect on welfare, i.e. the e¤ect of a tax increase in country B on social surplus in country A. Making use of the envelope theorem, we get

$$\frac{@W_A}{@t_B} = ½t_A \left[F_1^A \frac{@K_A}{@t_B} + S\frac{@G}{@t_B} \right] ¡ a[F^B ¡ GS] \qquad (23)$$

In (23), an increase in t_B has two opposite e¤ects 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 e¤ects. In addition, the tax increase lowers after-tax pro…ts on the part of the MNE, and to the extent the company is owned by country A's residents, this reduces social surplus. The latter third e¤ect 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, MNE after-tax pro…ts read

$$¦^{FA} = (1 ¡ t)[F^A + F^B ¡ S] ¡ RK ¡ H(G);$$

with the average tax rate t de…ned as in section 4 above. Tax revenue in country A amounts to

$$V_A = t_A \frac{K_A}{K}[F^A + F^B ¡ S];$$

while social surplus a fortiori is measured as

$$W_A = ½V_A + a¦^{FA}:$$

Again, …rst order conditions on the part of the MNE are unchanged. Making heavy use of the envelope theorem we obtain

$$\frac{@W_A}{@t_B} = ½t_A \left[(F^A + F^B ¡ S)\frac{K_B \frac{@K_A}{@t_B} + K_A \frac{@K_B}{@t_B}}{K^2} + F_1 \frac{K_A}{K}\frac{@K}{@t_B} \right]$$
$$¡ a(F^A + F^B ¡ S)\frac{@t}{@t_B}: \qquad (24)$$

As explained previously, the cross-e¤ect on tax revenue under FA is of ambiguous sign, as it consists of a positive and a negative e¤ect. In addition, the tax in country B increases the MNE's e¤ective average tax and thereby lowers after-tax pro…t income received by shareholders in country A.

6.3 Comparison of SA and FA

In what follows we assume that the two tax rates t_A and t_B are identical at the outset. As tax policy in the two countries now has multiple aims, viz. obtaining tax revenue and securing MNE pro…ts 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 MNE under consideration must be symmetrically owned in the two countries, that is, a must be equal to one half.[23]

The assumption of a = 1=2 and identical tax rates at the outset simpli…es the two expressions for social surplus changes above and renders a comparison between the two particularly simple. In fact, we easily establish

$$\left.\frac{@W_A}{@t_B}\right|_{SA} > \left.\frac{@W_A}{@t_B}\right|_{FA} \quad \text{¡¤} \quad \left.\frac{@V_A}{@t_B}\right|_{SA} > \left.\frac{@V_A}{@t_B}\right|_{FA} \tag{25}$$

Therefore, all our results in section 5 as to when the cross e¤ects (on revenue there, on welfare here) under SA are higher than those under FA, etc., go through here with no modi…cations. It is also easily seen that as an alternative to the A-MNE being symmetrically owned in the two countries, a situation in which an A-MNE is owned at home in country A to the extent a, and a similar B-MNE is owned in its home country (B) likewise to the degree a, would also produce the equivalence just mentioned. Full symmetry and balanced ownership in one form or the other is accordingly required for the results as to the relative size of tax spillovers to be equivalent under revenue maximization and under maximization of welfare.

7 Discussion

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

[23] If, say, the MNE was primarily owned in country A, and there were no other MNEs to take into account, this asymmetry would be re‡ected in country B choosing a greater optimal rate of tax than country A, because it would attach a smaller weight to pro…t ‡ows and a higher relative weight to tax revenues.

pressure. Analysts 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.

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, 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.

In this paper we have given certain aspects of SA and FA a closer look. Speci…cally, we have studied the …scal externalities operating under these tax systems. We employed a symmetric model of two countries and MNEs which operated entities in either country. Having characterized how the MNE's capital stock and use of a public input depended on corporate tax rates in the two countries, we looked at the cross-e¤ects of a tax hike in one country on tax revenue (or welfare) in the other. Comparing these under SA and FA we were …nally able to conclude as follows: If the pure pro…ts harvested by the MNE are either very low or very high, and at the same time 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.

The upshot, hence, is that the choice between SA and FA is not a clear-cut one, so that it is doubtful whether Formula Apportionment is the answer to the problems encountered by today's Separate Accounting system. Add to this that we have in our analysis presumed a high degree of coordination between countries in arranging FA; in particular, a common de…nition of the overall surplus on the part of MNEs was used, and the same apportionment formula was applied in each country to delimit its taxable income share. Such degree of coordination between sovereign countries is questionable, at best.

Our analysis has in a sense focused on 'average' or 'typical' tax spillovers between countries applying either SA or FA in the corporate tax system, 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 …nd 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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