

Consumption and Cash-Flow Taxes in an International Setting

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Abstract

We model the effects of consumption-type taxes which differ according to the base and location of the tax. Our model incorporates a multinational producing and selling in two countries with three sources of rent, each in a different location: a fixed basic production factor (located with initial production), mobile managerial skill, and a fixed final production factor (located with consumption). In the general case, we show that for national governments, there are tradeoffs in choosing between alternative taxes. In particular, a cash-flow tax on a source basis creates welfare-impairing distortions to production and consumption, but is partially incident on the owners of domestic production who may be non-resident. By contrast, a destination-based cash-flow tax does not distort behavior, but is incident only on domestic residents.

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1. Introduction

It is generally understood that the distortionary effects of capital income taxation are magnified in open economies. For example, the standard theoretical model suggests that the optimal effective marginal tax rate of a source-based capital income tax in a small open economy is zero (see Gordon, 1986). Raising this tax rate increases the required pre-tax rate of return in that location; this reduces the quantity of capital located there, which in turn creates an excess burden which could be avoided by taxing immobile factors directly.

One alternative to income taxation is consumption-type taxation. This paper investigates the effects of different types of consumption-type taxation on factor allocation, production and consumption in a two-country framework. Our particular interest is in three versions of the business cash-flow tax levied on business profit.¹ These differ in how the profit is allocated across the two countries. We analyze the case where aggregate profit is allocated by an apportionment factor based on the location of sales; a “destination” tax which, like a VAT, exempts exports but taxes imports; and a conventional source-based tax. We explore and compare the efficiency properties of each of these forms of taxation. We show that there are many potential distortions even when capital income is excluded from the tax base, so that the tax is based only on profit or economic rent. We also examine a game played between the two countries to consider what the non-cooperative outcome would be if the two countries chose their tax systems independently. In particular, starting from the most common form of taxation, the source-based tax, we analyze whether

¹ These three can be thought of, for example, as variants of the R-based tax of Meade et al. (1978), although since we do not include debt in our model, this would be equivalent to the R+F based tax.

countries have an incentive to switch at least part of their tax system to one of the other forms. While we focus primarily on a switch to a destination-based tax, we also consider the differences between this potential reform and the one where a sales-apportioned tax is the alternative.

We model a representative multinational company which takes all prices as given, and which is owned equally by two representative consumers, one in each country. The company has a production plant in each country that supplies either or both consumers. The final good differs between countries depending on local conditions – for example, a car must be prepared as right- or left-hand drive. The company exports an intermediate product between the two countries, and completes the final product in the country in which it is sold and consumed.

The company generates profit in three ways. First, it has the use of a fixed factor in each production location of the intermediate good, which implies that there are decreasing returns to scale in the other two factors, capital and managerial skill. The existence of the fixed factor generates profit in the country of production. This factor can be thought of, for example, as a local supply network that has been built up in each country, and which is available to the multinational to support production. Second, we also assume that there is a fixed factor in process of adjusting the intermediate good for the local market, which generates profit in the country of consumption. Third, the company owns a fixed supply of a factor that can move freely between the two countries. We refer to this factor as managerial skill, but one can just as easily think of it as a stock of intangible assets. The profit generated from access to this asset is mobile between the two countries.

Within this framework, even taxes on business profits, which do not distort the allocation of capital investment, can affect economic behavior. For example, consider the effects of a source-based cash-flow tax applied to the company in each country, where the home country has a higher tax rate. Other things being equal, and even in the absence of manipulating the transfer price of the intermediate good for tax reasons, the company would prefer to shift production of the intermediate good to the lower-taxed country, and export the intermediate good back to the home country to serve the domestic market. In addition, the company will have an incentive to inflate the transfer price at which the intermediate good is sold, since this will raise taxable profit in the foreign country and reduce it in the home country. This in turn creates a further incentive to shift production to the foreign country. So even under a cash-flow tax, the company will have an incentive to shift production to the foreign country, where the tax rate is lower.²

By contrast, a destination-based tax implemented in both countries along the lines of a VAT (but with labor costs deductible) would be efficient, equivalent to a lump-sum tax. This stems from the assumption that the representative consumer is immobile. A tax based solely on the revenue generated in each market cannot be avoided by switching factors of production (and trade flows) between countries.

A source-based cash-flow tax does have an attractive property, even though it causes distortions, including to the location of production. The incidence of such a tax falls to some extent on the owners of the company. As long as the company is at least partly owned by non-residents, then the source-based tax is partly incident on those non-

² Note that this depends on production taking place in both countries. If the company chooses to produce in only one country, then its discrete choice of which country to choose will depend on the tax rate. Bond and Devereux (2002) compare the properties of source- and destination-based taxes in this framework.

residents. In a non-cooperative setting, then, there is generally a trade-off for governments in setting a source-based tax rate. On the one hand, a higher tax rate induces a deadweight cost due to distortions induced by a switch of production between countries; on the other hand the country benefits since part of the incidence of the tax falls on non-residents.

Beginning with the standard case in practice of only a source-based tax in each country, we ask whether the home government has an incentive to switch part of its tax base away from the source base to either a destination base or a sales tax on the good produced by the multinational. In the general case, it is not possible to identify whether the government should do this or not. The reason is the tradeoff just mentioned between the benefit of taxing non-residents as against the deadweight loss imposed by the source-based tax.

However, this benefit of the source-based tax may not present in an alternative framework which we model. In this framework, the rent earned by the fixed factors (associated with initial production and final production) accrue to domestic residents rather than to the multinational. This generates a direct benefit to the representative residents from attracting each element of production activity, in that the prices of the fixed factors are bid up. In this case, the only sources of measured company profits (which we continue to assume are shared equally between jurisdictions) are the returns to managerial skill and, at the level of the individual country, transfer pricing manipulation. In this setting, it is possible to show that a switch to the destination based tax would be beneficial for the simple case in which the initial equilibrium is symmetric.

This result appears to be at odds with several claims in the literature regarding the equivalence of destination and source-based taxes. In the last model, the only remaining

distortion is the choice of where to locate managerial skill. That implicitly reflects a transfer pricing decision, since in our model this factor can be allocated freely, and hence in effect the transfer price is zero. If instead, we assumed that the factor was wholly owned in one country, and that its transfer to the other country was appropriately priced, then even this distortion would disappear, and, with transfer pricing more generally assumed to reflect true underlying costs, the source-based tax, like the destination-based tax, would be equivalent to a lump-sum tax. This is implicitly the framework underlying the contributions of Auerbach (1997), Bradford (2003) and others, resulting in the claim that destination-based and source-based consumption taxes are equivalent.³ We show in this paper the nature of the assumptions that need to be made for such an equivalence to hold.⁴

The remainder of the paper is organized as follows. Section 2 sets up the base case model. Section 3 analyzes the impact of different taxes when both countries adopt the same form of taxation. Given that source-based taxes are dominant in practice, Section 4 addresses the question of whether, starting from the case in which both countries impose a source-based tax, the home country has an incentive to switch part of its tax base to one of the alternatives considered in Section 3. Section 5 concludes.

³ See also Avi-Yonah (2000), and Grubert and Newlon (1997).

⁴ In that respect, this paper relates closely to the literature investigating the comparison between VAT levied on a destination or origin (i.e. source) basis. A comprehensive analysis of alternative locations of the VAT base was provided by Lockwood (2001), who synthesized a number of earlier contributions. Our model differs substantially, focusing particularly on firm-level decisions and several variations in tax structure as opposed to modeling the consumption side in more detail. Nevertheless, the results are broadly consistent: Lockwood finds that destination and origin bases are only equivalent in the presence of perfect competition and factor immobility. This would also be true in our model, though as noted above, mobile managerial skill would not overturn this result under appropriate transfer pricing. Beyond this, Lockwood (building on Lockwood, 1993, and Keen and Lahiri, 1998) also finds that the introduction of imperfect competition destroys this equivalence. We do not model imperfect competition in this paper.

2. The Model

There are two countries. Each country has a representative agent with a utility function of the form

$$(2.1) \quad U = u(c_1) + c_2 + v(g); \quad U^* = u^*(c_1) + c_2^* + v(g^*)$$

where c_1 and c_2 represent consumption of goods 1 and 2 respectively, g is a local public good, and the asterisk denotes the foreign country. To make the model tractable, we assume that there are no income effects in the demand for good 1. In general, we allow the shape of the utility function for good 1 to differ between the two countries.

In each country there is one unit of an endowment good. Production of one unit of good 2 in each country uses one unit of endowment. The production of good 2 is therefore characterized by constant returns to scale, and is assumed to be perfectly competitive, so that there are no profits. Good 2 can be used as a public good (g) or as consumption (c_2), with the remainder supplied as capital to the world capital market. Hence, the total world supply of capital (K) is

$$(2.2) \quad K = (1 - c_2 - g) + (1 - c_2^* - g^*) = k + k^*$$

where k is the amount of capital used in the home country and k^* is the amount used abroad. It may be useful to think of good 2 as labor, in which case c_2 represents the consumption of leisure by the representative individual.

Good 1 is produced by a single representative multinational, which takes all prices as given. The production of good 1 occurs in two stages. In the first stage, the multinational produces a basic good in both countries, and in its production has access to capital and two

additional factors, both in fixed supply. One factor is a local supply network that has been built up in each country, and which is available to the multinational to support production. The second is access to a factor, M , which can be used for production in either location. Thus,

$$(2.3) \quad M = m + m^*$$

where m is the amount of this factor used in the home country and m^* is the amount used abroad. One may think of this factor as managerial skill, or some other firm-specific asset. The key, for our purposes, is that its location is not fixed in either jurisdiction.

We assume that the basic production function used by the multinational is the same in both countries, $f(k, m)$, and that there are decreasing returns to scale because of the fixed factor representing the local supply network. There are no transportation costs, so without taxes the locations of production and consumption are unrelated. Hence

$$(2.4) \quad x_1 + x_1^* = f(k, m) + f(k^*, m^*)$$

where x_1 and x_1^* are the output from the production processes consumed in the home and foreign country respectively. The locations of capital production and capital use are also unrelated.

The second stage of good-1 production involves making a final product tailored to consumption in the respective countries, due to local tastes. For example, cars must be adjusted to be left-hand or right-hand drive, depending on local law. This links consumption of good 1 in each country with the basic output sold in that country, according to a common second stage production function, $h(\cdot)$,

$$(2.5) \quad c_1 = h(x_1) ; c_1^* = h(x_1^*)$$

where c_1 and c_1^* are the quantity of sales of the multinational in each country, and $h(\cdot)$ is assumed to be decreasing returns to scale.

Although we model a representative company, we assume that there are many such companies which determine the price in equilibrium. Any single company therefore takes the output price as given. Conditional on the consumer price in each country, decreasing returns to scale of $h(\cdot)$ leads to different values associated with x in the two countries. If, for example, there is a stronger demand for good-1 consumption in country 1, then this will lead to more consumption, and higher consumption rents in that country.

Ownership of the multinational, and hence profit (π), is shared equally between the two countries' representative agents.⁵ The profits have three components: returns to the fixed factor in basic production, returns to managerial skill, and returns to the fixed factor in final production. The effective locations of these components differ. The return to the fixed factor in basic production is located in the country hosting that fixed factor; the return to managerial skill is mobile, and depends on the location of the managerial skill itself; and the return to the fixed factor in final production is located in the country of consumption. The differences in location for these components of profits are important in modeling the impact of alternative taxes.

We now consider the effects of using different types of taxes to raise revenue to finance public goods. Initially, we consider only cases in which both governments adopt the same tax base; in Section 3 we consider the incentives to deviate from a common tax base.

⁵ Without any loss of generality, one can think of there being several identical multinationals with different ownership shares at home and abroad that aggregate to equal domestic and foreign ownership.

3. Alternative Tax Regimes

All tax regimes we consider either implicitly or explicitly exempt from tax the normal returns to capital, K . While much of the literature on the taxation of multinationals has focused on capital taxation, our focus here is on the taxation of rents.

3.1. Uniform domestic consumption tax

As a useful benchmark, suppose that the home country imposes a tax at tax-inclusive rate t on consumption of goods 1 and 2, and the foreign country imposes a tax of the same form, at rate t^* . Define p_1 and p_2 to be the home-country consumer prices, inclusive of tax, of goods 1 and 2 respectively with the same notation convention abroad. Taxes are therefore

$$(3.1) \quad T = t\{p_1c_1 + p_2c_2\}; \quad T^* = t^*\{p_1^*c_1^* + p_2^*c_2^*\}$$

As there are no taxes on production, the producer price of the numeraire good 2 remains equal to 1 in both countries. This implies that the consumer prices of good 2 become $1/(1-t)$ and $1/(1-t^*)$. With these prices, the conditions for utility maximization become:

$$(3.2) \quad u'(c_1) = \frac{p_1}{p_2} = (1-t)p_1; \quad u'(c_1^*) = \frac{p_1^*}{p_2^*} = (1-t^*)p_1^*,$$

and after-tax profits of the multinational are (with the second line using (3.2)):

$$(3.3) \quad \begin{aligned} \pi &= p_1(1-t)c_1 + p_1^*(1-t^*)c_1^* - K \\ &= u'(c_1)h(x_1) + u'(c_1^*)h\{f(k, m) + f(K-k, M-m) - x_1\} - K. \end{aligned}$$

Maximizing profit with respect to k , m , K , and x_1 and yields the following first-order conditions for profit maximization of the multinational:

$$(3.4) \quad f_1(k, m) = f_1(k^*, m^*)$$

$$(3.5) \quad f_2(k, m) = f_2(k^*, m^*)$$

$$(3.6) \quad u'(c_1^*)h'(x_1^*) = \frac{1}{f_1(k^*, m^*)}$$

$$(3.7) \quad u'(c_1)h'(x_1) = u'(c_1^*)h'(x_1^*)$$

Conditions (3.4) and (3.5) call for production efficiency, with the marginal product of capital equal across the two countries, and also the marginal product of managerial skill equal across the two countries. Condition (3.6) calls for setting marginal revenue equal to marginal cost, which in this case also implies no consumption distortion. Condition (3.7) implies that marginal revenues, in this case equal to marginal consumer valuation, should be independent of consumption location.

Finally, the household budget constraint becomes

$$(3.8) \quad u'(c_1)c_1 + c_2 = (1 - t) \left(1 + \frac{(u'(c_1)c_1 + u'(c_1^*)c_1^* - K)}{2} \right),$$

with the equivalent for the foreign country. That is, a uniform consumption tax acts like a lump-sum proportional tax on endowment plus profits.

3.2. Domestic sales tax on good 1 only

While the previous case is a useful benchmark for the effects of nondistortionary taxation, the interpretation of good 2 as leisure suggests that it is more realistic to consider

good 2 to be untaxed consumption.⁶ With no tax on good 2 in either country, the consumer prices of good 2 are 1 in both countries, and individual maximization yields

$$(3.9) \quad u'(c_1) = \frac{p_1}{p_2} = p_1; \quad u^*(c_1^*) = \frac{p_1^*}{p_2^*} = p_1^*$$

After-tax profits are therefore:

$$(3.10) \quad \begin{aligned} \pi &= (1-t)p_1c_1 + (1-t^*)p_1^*c_1^* - K \\ &= (1-t)u'(c_1)h(x_1) + (1-t^*)u^*(c_1^*)h\{f(k, m) + f(K-k, M-m) - x_1\} - K \end{aligned}$$

Maximization with respect to k and m will still yield production efficiency, since all the terms in k and m are multiplied by $(1-t^*)$. However, conditions (3.6) and (3.7) become

$$(3.11) \quad (1-t^*)u^*(c_1^*)h'(x_1^*) = \frac{1}{f_1(k^*, m^*)}, \text{ and}$$

$$(3.12) \quad (1-t)u'(c_1) = (1-t^*)u^*(c_1^*)h'(x_1^*)$$

The consumer choice of good 1 is therefore distorted in each country.

3.3. Business profits tax with apportionment by sales

Formula apportionment has often been considered as a solution to the difficulty of determining the location of the tax base, and has recently been proposed by the European Commission as a replacement for existing corporation taxes in Europe. Its properties have been analyzed by Gordon and Wilson (1986), who demonstrated that for a standard corporate income tax, a three-factor formula based on the location of property, payroll and sales could be examined as, in effect, three forms of distortionary taxation. It is clear that a

⁶ One might also think of good 2 as local production by small producers below a taxpaying threshold.

formula based on property or payroll would affect location incentives. We therefore focus on the case where the apportionment factor is solely the destination of sales – that is, where the consumer resides, as is increasingly used among US states and has been proposed for the international level by Avi-Yonah and Clausing (2008). We further consider the case in which the tax base itself is a business cash-flow tax.⁷

We assume here that the apportionment factor is based on the location of the consumption of good 1 only, rather than on goods 1 and 2. This would follow naturally if the multinational does not also produce good 2, or if good 2 represents leisure. This assumption implies that sales of good 2 in either country have no impact on the firm's tax payments.⁸ Consequently, the equilibrium competitive price for good 2 will still be 1, and the utility maximization conditions in expression (3.9) still holds. Post-tax profits are:

$$(3.13) \quad \pi^n = (p_1 c_1 + p_1^* c_1^* - K)[1 - ta - t^*(1 - a)];$$

where
$$a = \frac{p_1 h(x_1)}{p_1 h(x_1) + p_1^* h(x_1^*)} = \frac{p_1 c_1}{p_1 c_1 + p_1^* c_1^*}.$$

Using (3.13), we can derive the firm's optimal conditions with respect to k , m , K , and x_1 . For the condition with respect to k , we have:

$$(3.14) \quad [1 - ta - t^*(1 - a) + \frac{a(t-t^*)\pi}{p_1 c_1 + p_1^* c_1^*}] p_1^* h'(x_1^*) [f_1(k, m) - f_1(k^*, m^*)] = 0$$

⁷ We abstract from issues concerning debt and the treatment of interest, by implicitly assuming the multinational is equity financed.

⁸ If sales of good 2 were included in the apportionment formula, for example if the multinational were an integrated producer of goods 1 and 2, this would lead to an additional distortion. The firm would be encouraged to shift sales of low-margin products, in this model good 2, from the high-tax country to the low-tax country, to reduce the share of its overall sales in the high-tax country. In a more general model with sales of intermediate production inputs (absent from our model because the two stages of good-1 production occur within the same firm), there would be a second additional distortion, through the implicit taxation of intermediate sales along the lines of the implicit taxation of final goods sales described in expression (3.14). See Auerbach (2011) for further discussion of these distortions.

Hence, the term $(f_1 - f_1^*)$ must equal 0 and (3.4) still holds; likewise, so does condition (3.5), so there is still production efficiency.

The remaining two conditions, with respect to K and c_1 , imply

$$(3.15) \quad \left[1 + \frac{a(t-t^*)\pi}{(1-t)p_1c_1+(1-t^*)p_1^*c_1^*} \right] p_1^* h'(x_1^*) = \frac{1}{f_1\left(\frac{K}{2}, \frac{M}{2}\right)}$$

where we have here used the conditions for production efficiency. Expression (3.15) indicates that there will be an effective tax or a subsidy on consumption according to whether the home tax rate is higher or lower than the tax rate abroad. So if $t > t^*$, for example, sales are discouraged at home and encouraged abroad by the incentive to shift the location of profits for tax purposes.

As for a domestic sales tax on good 1 only, apportioning a cash-flow tax based on the destination of sales will generally distort consumption in both countries, although it will not distort production in this particular set-up with intermediate inputs not involved in the tax computation. It thus has impacts similar to sales taxes on good 1 in our model. Since sales taxes are more straightforward to analyze, we focus on those in the remainder of the paper.

3.4. Destination-based cash-flow tax

We now consider a tax with the same cash-flow base, but with the tax liability in each country base determined by the destination of sales, as under a VAT.

Consider first the tax treatment of sector 2. In the absence of any trade in good 2, profits are zero and tax from this sector is zero. But with trade then an import of good 2 would be subject to the import tax at rate t or t^* . The price of the domestically produced

good 2 must be the same as for imported goods. Further, if the sector is a net exporter, then its tax will be negative. The tax liability in sector 2 and on imports together is:

$$(3.16) \quad T_2 = t\{p_2(c_2 + k + g) - w\}$$

where w is the producer price of the endowment. If $(c_2 + k + g) < 1$ then the home country exports good 2 (or capital) and $T_2 < 0$. If $(c_2 + k + g) > 1$ then $T_2 > 0$ is a tax on imports. The opposite holds for the foreign country. If $(c_2 + k + g) < 1$, the post-tax zero-profits condition is:

$$(3.17) \quad \pi_2 = (1 - t)\{p_2(c_2 + k - g) - w\} + (1 - t^*)p_2^*(1 - c_2 + k - g) = 0$$

which is solved by $p_2 = w = 1/(1 - t)$ and $p_2^* = 1/(1 - t^*)$. That is, the prices of good 2 and the endowment good are grossed up by $(1 - t)$ in the home country and $(1 - t^*)$ in the foreign country. The goods exported to the foreign country are taxed at rate t^* , and so are the same price as domestically produced goods in that country. Condition (3.2) therefore holds, as for the uniform domestic consumption tax. If $c_2 + k + g > 1$, post-tax profit is zero, but the price of good 2 must reflect the import tax and so is again grossed up.

After tax profits in sector 1 (and hence overall as well) are:

$$(3.18) \quad \pi = (1 - t)\{p_1c_1 - p_2k\} + (1 - t^*)\{p_1^*c_1^* - p_2^*(K - k)\} = u'(c_1)c_1 + u^*(c_1^*)c_1^* - K$$

The household budget constraint is:

$$(3.19) \quad p_1c_1 + p_2c_2 = w + \left(1 + \frac{u'(c_1)c_1 + u^*(c_1^*)c_1^* - K}{2}\right)$$

$$\Rightarrow u'(c_1)c_1 + c_2 = 1 + (1 - t) \left(\frac{u'(c_1)c_1 + u^*(c_1^*)c_1^* - K}{2}\right)$$

with an equivalent condition for the foreign country.

This expression makes it clear that the destination-based tax is equivalent to a tax on the pure profits received by domestic residents, Comparing (3.19) and (3.8), we note that this outcome is similar to what occurs under the uniform tax on consumption, but in this case the good-2 endowment is excluded from the tax base. Note that, if one thinks of good 2 as leisure, then the lack of distortion here can also be thought of a relating to the fact that our destination-based cash-flow tax excludes labor from the tax base, unlike a standard VAT. With a labor-leisure trade-off, of course, a uniform VAT on market consumption expenditures would distort labor supply, and would be equivalent to the sales tax on good 1 considered above.

3.5. Source-based cash-flow tax

We now consider a third version of the cash-flow tax, in this case one allocated using the source principle that is the standard approach of existing international tax systems.

For this tax, there would be no taxes in the competitive sector 2, so $p_2 = 1$. Hence, the prices of good 1 in the two countries are governed by expression (3.9). We assume that the final level of production, turning x into the final good 1, takes place in the country of consumption.⁹ Define e to be exports of the unfinished good 1 (i.e. x) from the home country plant to the foreign country plant at price q and e^* to be exports of good 1 from the foreign country plant to the home country plant at price q^* . Then profit earned by the home country plant is $\pi_1 = (1 - t)\{p_1 h(f(k, m) - e + e^*) + qe - q^*e^* - k\}$ and that earned by the foreign plant is: $\pi_1^* = (1 - t^*)\{p_1^* h(f(k^*, m^*) - e^* + e) + q^*e^* - qe - k^*\}$. Total profit after tax is:

⁹ In addition to customization for local markets, one can think of this final production stage as including advertising, distribution, and other activities that take place in the proximity of consumption.

$$(3.20) \quad \pi = (p_1 c_1 - k)(1 - t) + (p_1^* c_1^* - k^*)(1 - t^*) + (q^* e^* - qe)(t - t^*).$$

Conditional on production and consumption in the two countries, $(e - e^*)$ is determined, but not the individual gross exports. This arises because there are no transportation costs, which implies that the firm can choose where to produce for each market. With production and consumption in each country given, unit increases in both e and e^* lead to a net increase in after-tax profits of $(q^* - q)(t - t^*)$.

The prices q and q^* are internal transfer prices of the multinational company. Since there are no observable arms' length prices, it may be open to the company to manipulate these internal prices to reduce its tax liability. But it is useful first to consider a benchmark price. A natural benchmark arises if we treat the multinational as having four independent plants, two in each country, each of which takes prices as given. In each case plant A uses k to produce x and plant B uses x to produce the final good c . Consider the case where there are no exports, in which case the profits of the two home country plants are $\pi_A = (1 - t)\{qf(k, m) - k\}$ and $\pi_B = (1 - t)\{p_1 h(x_1) - qx_1\}$. Plant A chooses k to maximize its profit and plant B chooses $x_1 = f(k, m)$ to maximize its profit. What value of q would yield the same outputs as in the case where these two plants were combined, i.e., the value of $k = \hat{k}$ for which $p_1 h'(x_1) f_1(\hat{k}, m) = 1$? The answer is $q = 1/f_1(k, m)$, the marginal cost of producing x . That is, if the transfer price is set equal to the marginal cost of plant A, then outputs would not be affected by splitting the home plant into two parts. The same applies to the case in which the intermediate good is exported, and holds even in the presence of the two cash flow taxes analyzed here, so in addition we have $q^* = 1/f_1(K - k, M - m)$.

We discuss below the possibility that the multinational can exploit the absence of an arms' length price to manipulate its transfer prices in order to shift profit between the two

countries. But while we allow the firm considerable latitude in its choice of transfer prices q and q^* , we assume that tax enforcement is sufficiently effective that the firm cannot choose different values for the two, for example exporting at a high price from the low-tax country and then importing back from the high-tax country at a low price. This means that, even in the absence of transportation costs, the firm can gain no benefit from cross-hauling.

With $q = q^*$ in expression (3.20), there are four possible regimes:

Case A: $e^* = 0$ and $e = f(k, m) - x_1 = x_1^* - f(k^*, m^*) > 0$ and $t < t^*$

Case B: $e = 0$ and $e^* = f(k^*, m^*) - x_1^* = x_1 - f(k, m) > 0$ and $t > t^*$

Case C: $e^* = 0$ and $e = f(k, m) - x_1 = x_1^* - f(k^*, m^*) > 0$ and $t > t^*$

Case D: $e = 0$ and $e^* = f(k^*, m^*) - x_1^* = x_1 - f(k, m) > 0$ and $t < t^*$

In the first two cases, the high-tax country is importing, so the firm will wish to maximize q .

In the last two cases, the high-tax country is exporting, and the firm will wish to minimize q .

In all four of these cases, $e^* - e = x_1 - f(k, m)$. Making this substitution in (3.20) generates general first order conditions as follows:

$$(3.21) \quad x_1: \quad (1 - t)(p_1 h' - q) - (1 - t^*)(p_1^* h^{*'} - q) = 0$$

$$(3.22) \quad K: \quad p_1^* h^{*'} = \frac{1}{f_1^*}$$

$$(3.23) \quad k: \quad p_1^* h^{*'}(f_1 - f_1^*)(1 - t^*) + (1 - q f_1)(t - t^*) = 0$$

$$(3.24) \quad m: \quad p_1^* h^{*'}(f_2 - f_2^*)(1 - t^*) - q f_2(t - t^*) = 0$$

With marginal cost pricing, i.e., $q = \frac{1}{f_1} = \frac{1}{f_1^*}$, these conditions simplify to:

$$(3.21') \quad p_1 h' = \frac{1}{f_1}$$

$$(3.22') \quad p_1^* h^{*'} = \frac{1}{f_1^*}$$

$$(3.23') \quad f_1 = f_1^*$$

$$(3.24') \quad f_2(1 - t) = f_2^*(1 - t^*)$$

In this case, unlike under source-based capital *income* taxes, there is no distortion to the allocation of capital because the normal return to capital is tax-exempt under a cash-flow tax. Likewise, there is no distortion in the second stage of production, where consumption rents are generated, as the tax on these rents simulates the effects of a tax on pure profits.¹⁰ But returns to managerial skill show up in the tax base where this factor is used in production, so the firm is deterred from using it where the tax rate is high.

More generally, the opportunity to manipulate transfer prices not only benefits the firm, but also affects its production decisions. Consider first Case A, with $t < t^*$, where the home plant is exporting, and where the firm wishes to maximize q . From (3.23), $q > \frac{1}{f_1}$ implies that $f_1 < f_1^*$. That is, with transfer pricing manipulation, the firm shifts production from the foreign country to the home country, reducing f_1 and increasing f_1^* . Relative to the marginal cost pricing case, in this case one can also show that $q > \frac{1}{f_1}$ would also increase $f_2^* - f_2$, pushing more intellectual property to the home country. Thus, exports from the home country increase. By symmetry, the same result, that exports from the low-tax country increase, will hold for Case B. Now consider Case C, with $t > t^*$, where again the home firm is exporting, but now the firm wishes to minimize q . From (3.23) $q < \frac{1}{f_1}$ implies that $f_1 < f_1^*$. That is, with transfer pricing manipulation, production is again shifted from

¹⁰ The same is true, implicitly, of the use of location-specific rents in the first stage of production.

the foreign country to the home country, reducing f_1 and increasing f_1^* . Relative to the marginal cost pricing case, in this case $q < \frac{1}{f_1}$ would reduce $f_2 - f_2^* > 0$, again pushing more intellectual property to the home country. Thus, transfer-pricing manipulation again increases exports from the home country. By symmetry, the same result, that exports from the high-tax country increase, will hold for Case D.

Thus, we have the interesting result that, regardless of whether the high-tax or low-tax country exports, the ability to manipulate transfer prices makes export activity more attractive and causes the firm to adjust the location of production accordingly. Note that, contrary to the standard view on the subject, the ability of the firm to manipulate transfer prices does not necessarily lead the firm to shift *production* to the low-tax country, unless the firm would export from the low-tax country in the absence of transfer pricing manipulation. Certainly, by expression (3.24'), other things being equal the firm already will have the tendency to locate one of its production factors, managerial skill, in the low-tax country, increasing that country's production level and making it more likely to export. On the other hand, the low-tax country might also have a stronger demand for good 1, increasing the likelihood that it would import.

Another interesting effect of transfer pricing manipulation is how its effects on production decisions interact with the basic ones of the source-based system. While the capital-allocation decision is clearly distorted, for it starts from an undistorted point (see expression (3.23')), the effect on the allocation of managerial skill could go either way. In particular, in cases C and D, where transfer pricing manipulation leads the high-tax country to increase its exports, this pushes more managerial skill to the high-tax country, thereby offsetting the initial distortion observed in expression (3.24').

4. Would Countries Choose to Deviate from a Source-Based Tax?

Since source-based taxes are a standard form of taxation, it is worth asking whether an individual country would have an incentive to move to a different tax base, starting from an equilibrium in which each country relies only on a source-based tax. Because of the complexity of the question, we begin by assuming in analyzing it that the two countries have the same utility functions, so that there will be a symmetric equilibrium under the initial source-based tax, with the same initial tax rate and no net exports.¹¹ We then go on to consider the more complex case without symmetry.

We also assume a Nash equilibrium, that is, that each country chooses its tax policy assuming that the policy of the other country is fixed. In this environment, we ask whether the home country would wish to deviate from the equilibrium by introducing either a small destination-based tax cash-flow tax or a small sales tax on good 1, which we showed to have similar effects to a cash-flow tax with sales-based formula apportionment. By the envelope theorem, we can ignore the benefits of changes in the level of government spending, assuming that the government always sets spending at its optimal level. Thus, we consider in each case the substitution of the new tax for the old, keeping public goods fixed.

Before we begin, note that under any tax system, for a government seeking to maximize the representative resident's utility, as given in expression (2.1), with respect to the tax rate, t , the first-order condition will be:

$$(4.1) \quad \frac{dY}{dt} + v'(g) \frac{dT}{dt} = 0 \Rightarrow g = v'^{-1} \left(-\frac{dY/dt}{dT/dt} \right)$$

¹¹ When symmetric equilibria exist we limit our attention to these and do not consider other possible equilibria.

where

$$(4.2) \quad \frac{dY}{dt} = \frac{1}{2} \frac{d\pi}{dt} - c_1 \frac{dp_1}{dt} - c_2 \frac{dp_2}{dt}$$

is the change in real income due to an increase in t , resulting from the direct change in nominal income plus the change in purchasing power due to price changes. The term $-\frac{dY/dt}{dT/dt}$ measures the *marginal cost of public funds*, accounting for the cost, from the country's perspective, of raising an extra dollar of revenue. Thus, when we consider differential changes that keep revenue fixed, we will be asking whether the policy change increases the real income of the country's representative agent. Two factors will play a role here. First, as in a domestic context, the marginal cost of public funds will be higher as the deadweight loss from taxation is higher. This factor will cause a shift to less distortionary taxes. Second, taxes may differ in the extent to which they can be exported, and the real income cost to *domestic* residents will be lower with higher tax exporting.

4.1. Would the home country adopt a destination-based cash-flow tax?

4.1.1. Symmetric case

Suppose that we start with a symmetric equilibrium in which both countries have equal source-based taxes, levied at rates $s = s^*$ and no other taxes. So that we do not have to keep track of associated prices changes, we assume for simplicity that the destination-based tax is implemented in its equivalent form of a lump-sum tax, at rate z , on the home country's share of profits (see expression (3.19)). Let ε be the experiment. Then the change in welfare with respect to ε equals $dY/d\varepsilon$, since government spending g is unchanged and

hence $dT/d\varepsilon = 0$. To keep revenue the same, the changes in s and z must satisfy:

$$(4.3) \quad \frac{ds/d\varepsilon}{dz/d\varepsilon} = \frac{dT/dz}{dT/ds},$$

from which it follows that $dY/d\varepsilon > 0$ if and only if

$$(4.4) \quad \frac{dY/dz}{dT/dz} > \frac{dY/ds}{dT/ds}.$$

From (4.2), the effects of changes in the two tax rates on real income are:

$$(4.5) \quad \frac{dY}{dz} = \frac{1}{2} \frac{d\pi}{dz} - c_1 \frac{dp_1}{dz}; \quad \text{and} \quad \frac{dY}{ds} = \frac{1}{2} \frac{d\pi}{ds} - c_1 \frac{dp_1}{ds}$$

since the price of good 2 equals 1 under both tax systems. In this case, $p_1 = u'(c_1)$ and at the symmetric equilibrium

$$(4.6) \quad \pi = (1 - z)\{(p_1 c_1 - k)(1 - s) + (p_1^* c_1^* - k^*)(1 - s^*)\},$$

We evaluate the change in this term at $z = 0$.

Since an increase in z is nondistortionary, its only behavioral impact will be to reduce g and c_2 ; prices, consumption of good 1 and capital are all unaffected. As a result,

$$(4.7) \quad \frac{dY}{dz} = -\frac{\pi}{2} = -\frac{dT}{dz}$$

This is true for any of the four regimes for the source-based tax, and so condition (4.4) therefore reduces to $dY/ds + dT/ds < 0$; that is, the increase in real income from reducing the source-based tax must be larger than the decline in revenue. Put another way, the marginal cost of public funds in the initial equilibrium must exceed 1 for the home country.

With respect to the effects of a change in the source-based tax, the effect on real income is:

$$(4.8) \quad \frac{dY}{ds} = \frac{1}{2} \frac{d\pi}{ds} - c_1 \frac{dp_1}{ds} = \frac{1}{2} \left\{ -(p_1 c_1 - k) + (1-s)c_1 \frac{dp_1}{ds} + (1-s^*)c_1^* \frac{dp_1^*}{ds} \right\} - c_1 \frac{dp_1}{ds},$$

where other terms in $d\pi/ds$ are zero by the envelope theorem.

Total tax levied is

$$(4.9) \quad T = z \frac{\pi}{2} + s(p_1 c_1 - k - q^* e^* + qe)$$

Before differentiating this expression with respect to s , we must consider which of the four regimes applies, since even though e and e^* will be zero in the initial symmetric equilibrium, this will not be the case once s and z change. By expression (3.24'), the reduction in s would shift production to the home country, absent any adjustment in q . And, as noted above, manipulating transfer pricing will only serve to increase exports from the home country. Given that a reduction in s implies that $s < s^*$ and that the home country will export, this implies that case A must hold, i.e., that $e^* = 0$ and $e = f(k, m) - x_1$.¹² Thus,

$$(4.10) \quad T = s(p_1 c_1 - k - qx_1 + qf(k, m)).$$

and so, (using $c_1 = h(x_1)$ and $\frac{df}{ds} = f_1 \frac{dk}{ds} + f_2 \frac{dm}{ds}$):

$$(4.11) \quad \begin{aligned} \frac{dT}{ds} &= p_1 c_1 - k - qx_1 + qf(k, m) \\ &+ s \left(c_1 \frac{dp_1}{ds} + (p_1 h' - q) \frac{dx_1}{ds} - (1 - qf_1) \frac{dk}{ds} + qf_2 \frac{dm}{ds} + (f(k, m) - x_1) \frac{dq}{ds} \right) \end{aligned}$$

¹² We show below that the pattern of production and consumption is consistent with this assumption.

In the initial symmetric equilibrium, $f(k, m) = x_1$. Also, because in this equilibrium the firm wishes neither to overstate nor understate its transfer price, we may assume that $q = 1/f_1$. Hence, (by (3.21')), $p_1 h' = q$. With these taken into account, (4.11) becomes:

$$(4.11') \quad \frac{dT}{ds} = p_1 c_1 - k + s \left(c_1 \frac{dp_1}{ds} + \frac{f_2}{f_1} \frac{dm}{ds} \right)$$

Combining (4.8) with (4.11') generates the following condition for an increase in welfare under a switch to the destination-based tax, i.e.: $dY/ds + dT/ds < 0$:

$$(4.12) \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 - k}{2} + \frac{(1-s)c_1}{2} \left(\frac{dp_1^*}{ds} - \frac{dp_1}{ds} \right)$$

However, we can simplify this expression further by showing that the consumer prices must remain equal to each other, assuming that we start at a symmetric equilibrium with marginal cost transfer pricing. From equations (3.21')-(3.24'), we obtain:

$$(4.13) \quad \frac{d(p_1 h)}{ds} = \frac{d(p_1^* h^*)}{ds}$$

$$(4.14) \quad \frac{d(p_1^* h^* f_1^*)}{ds} = 0$$

$$(4.15) \quad \frac{d(p_1 h' f_1)}{ds} = \frac{d(p_1^* h^* f_1^*)}{ds}$$

$$(4.16) \quad \frac{df_2}{ds} - \frac{df_2^*}{ds} = \frac{f_2}{(1-s)}$$

where the right-hand side of the last expression uses the fact that $p_1^* h^* = \frac{1}{f_1^*}$ from (3.22').

Combining the first three of these expressions implies that

$$(4.17) \quad \frac{df_1}{ds} - \frac{df_1^*}{ds} = 0$$

That is, starting from marginal-cost transfer pricing, there is no distortion of capital allocation because of the cash-flow tax base, even under source-based taxation. From (4.13) and the initial symmetry of equilibrium, we have:

$$(4.18) \quad \frac{dp_1^*}{ds} - \frac{dp_1}{ds} = -\frac{h''}{h'} p_1 \left(\frac{dx_1^*}{ds} - \frac{dx_1}{ds} \right)$$

However, given that marginal utility equals the price in each country, it also is the case that

$$(4.19) \quad \frac{dp_1^*}{ds} - \frac{dp_1}{ds} = u'' h' \left(\frac{dx_1^*}{ds} - \frac{dx_1}{ds} \right)$$

Since $-\frac{h''}{h'} p_1 > 0$ and $u'' h' < 0$, these two equations can hold simultaneously only if

$\left(\frac{dx_1^*}{ds} - \frac{dx_1}{ds} \right) = 0$. Hence, $\frac{dp_1^*}{ds} - \frac{dp_1}{ds} = 0$ and expression (4.12) becomes

$$(4.12') \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 - k}{2}$$

The left-hand side of this expression, which will be positive, represents the increased revenue generated from attracting managerial capital by reducing the source-based tax. This term reflects the efficiency gain from reducing the tax on a mobile factor. The right-hand side of the expression equals the net tax exporting that is given up by switching to the destination-based tax. Under a source-based tax, half of the tax on domestic profits is borne by foreign shareholders. But the destination-based tax, which taxes the domestic consumption financed by domestic residents' share of worldwide profits, is borne entirely by domestic residents. We have no definitive result about whether the inequality in (4.12') holds, although, *ceteris paribus*, a higher initial value of s would make the result more likely.

Note that, even though relative consumption doesn't change, production does shift.

Combining (4.16) and (4.17), we obtain:

$$(4.20) \quad \frac{dm^*}{ds} - \frac{dm}{ds} = -\frac{f_{11}}{D} \frac{f_2}{(1-s)} > 0$$

$$(4.21) \quad \frac{dk^*}{ds} - \frac{dk}{ds} = \frac{f_{12}}{D} \frac{f_2}{(1-s)} > 0$$

where $D = f_{11}f_{22} - f_{12}f_{21} > 0$ is the determinant of the Hessian of the production function.

Since both m and k shift abroad with an increase in s , it is obvious that the first stage of production shifts abroad. Put another way, as the home country *lowers* its source based tax, production shifts to the home country and the home country begins exporting, consistent with the assumption that Case A applies.

4.1.2. Asymmetric case

Now consider the more general case without imposing symmetry. Begin with the general expression for profit,

$$(4.22) \quad \pi = (1-z)[(p_1c_1 - k)(1-s) + (p_1^*c_1^* - k^*)(1-s^*) - q(e - e^*)(s - s^*)]$$

evaluated at $z = 0$. Using the fact that $e - e^* = f(k, m) - x_1$, we have (again using the envelope theorem to elimination terms associated with profit maximization):

$$(4.23) \quad \frac{dY}{ds} = \frac{1}{2} \left\{ \begin{array}{l} -p_1c_1 + k - q(f(k, m) - x_1) - (s - s^*)(f(k, m) - x_1) \frac{dq}{ds} \\ -(s - s^*)(q - 1/f_1) \frac{d(e - e^*)}{ds} + (1-s)c_1 \frac{dp_1}{ds} + (1-s^*)c_1^* \frac{dp_1^*}{ds} \end{array} \right\} - c_1 \frac{dp_1}{ds}$$

while dT/ds is the same as in (4.11). Combining these expressions, rearranging and using $p_1 h' = 1/f_1$ (from (3.22)¹³), we can write the condition for welfare improvement as:

$$(4.24) \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 + q(e - e^*) - k}{2} + \frac{(s + s^*)}{2} (q - 1/f_1) \left(\frac{d(e - e^*)}{ds} \right) \\ + \frac{1}{2} \left[(1 - s^*) c_1^* \frac{dp_1^*}{ds} - (1 - s) c_1 \frac{dp_1}{ds} + (s + s^*) (e - e^*) \frac{dq}{ds} \right]$$

The left-hand side of this expression is the same as that in (4.12). The first term on the right-hand side reflects the fact that profits based on domestic production must now incorporate the difference between domestic consumption and domestic production. The second term on the right-hand side reflects the change in profits due to increased exports for a given degree of transfer pricing manipulation; it equals zero with marginal cost pricing. To interpret the second line of (4.24), note that it can also be written as:

$$(4.25) \quad \frac{1}{2} \left[c_1^* \frac{dp_1^*}{ds} - s^* \left(c_1^* \frac{dp_1^*}{ds} - x_1^* \frac{dq}{ds} + f(k^*, m^*) \frac{dq}{ds} \right) \right] \\ - \frac{1}{2} \left[c_1 \frac{dp_1}{ds} + s \left(c_1 \frac{dp_1}{ds} - x_1 \frac{dq}{ds} + f(k, m) \frac{dq}{ds} \right) \right]$$

These terms reflect the changes in after-tax profits due to changes in final and intermediate goods prices. The first term is the increase in the domestic resident's share of foreign country profits due to a final-goods price increase, while the second term is the increase in the domestic resident's share of domestic profits, *net of* the real income loss associated with higher domestic prices. That is, the home country benefits from higher prices and profits earned abroad, but is hurt by higher prices and profits generated at home.

¹³ While this expression refers to the foreign country, the symmetry of the analysis implies that it holds for the home country as well.

To further interpret expression (4.24), it is useful to distinguish the effects of asymmetry per se and those due to the deviations from marginal cost transfer pricing that arise with cross-border trade and differences in tax rates. Without transfer-pricing manipulation, $q = \frac{1}{f_1} = \bar{q}$, so $\frac{dq}{ds} = \frac{d\bar{q}}{ds}$. For this case we may rewrite (4.24) as

$$(4.24') \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 + \bar{q}(e - e^*) - k}{2} \\ + \frac{1}{2} \left[(1 - s^*) c_1^* \frac{dp_1^*}{ds} - (1 - s) c_1 \frac{dp_1}{ds} + (s + s^*)(e - e^*) \frac{d\bar{q}}{ds} \right]$$

From this expression, we can see how different factors influence the home country's incentives to replace the source-based tax. One factor is the extent to which the home country exports. Rewriting the numerator of the first term on the right-hand side of (4.24') as $(p_1 c_1 - \bar{q} x_1) + (\bar{q} f(k, m) - k)$, we observe that an increase in domestic consumption, given the level of domestic production, increases the term by the extent of additional consumption rents. Because such rents are subject to tax under the source based tax, and only half of the burden of this tax falls on domestic residents, a higher value of the term discourages the home country from moving away from source-based taxation. From this term, then, higher imports discourage a shift away from source-based taxation.

The remaining terms in (4.24') relate to changes in the value of after-tax profits generated at home and abroad due to induced changes in the prices of final consumption and intermediate production. If an increase in s raises the profits generated at home, this makes source-based taxation less attractive to the home government, since half of these profits go to foreigners and all of the real income loss on the consumption side falls on domestic residents. The opposite incentive is associated with an increase in foreign-

generated profits, which benefit domestic residents. While the net impact of these terms will depend on the initial equilibrium, we can understand what is going on by considering some special cases.

First, suppose that the initial tax rates are equal, i.e., $s = s^*$. Since production will then be efficient, the level of production will be equal in the two countries. Also, as the following reasoning shows, prices will not change with an incremental change in s . Because there is no first-order deadweight loss starting from a position of production efficiency, the initial reallocation of production factors will not increase production costs; thus, for a given level of production, the marginal cost of production, \bar{q} , remains fixed. While there will be first-order incidence effects due to changes in the tax burden, these will not influence the demand for good 1 in either country, given our assumption of no income effects in the demand for this good. With no change in demand, and no change in the cost of the intermediate good, there will also then be no changes in either final goods price, p_1 or p_1^* . Starting from equal taxes, then, only the first term on the right-hand side of (4.24') is nonzero, making a move away from source-based taxation more (less) likely for a country with relatively weak (strong) demand for good 1.

Now, suppose instead that the initial tax rates differ, but that preferences for good 1 are the same. In this case, expressions (4.13)-(4.15) still hold (although (4.16) is different because s and s^* are not equal). Thus, it will still be the case that $\frac{dp_1^*}{ds} - \frac{dp_1}{ds} = 0$, so that the price and consumption level of good 1 will remain equal in the two countries as s changes. Now, though, production will differ in the two countries because of the tax incentive to shift managerial capital. In this case, the second term on the right-hand side of (4.24') becomes:

$$(4.26) \quad \frac{1}{2} \left[(s - s^*) c_1 \frac{dp_1}{ds} + (s + s^*) (e - e^*) \frac{d\bar{q}}{ds} \right]$$

Given the absence of income effects in demand, prices will increase only if production costs increase. Since the cost of capital is constant and the allocation of capital is not distorted, an increase in production costs, and hence the intermediate goods price \bar{q} and the output price p_1 as well, will occur if and only if the increase in s worsens the allocation of managerial capital.¹⁴ (Note that because managerial capital is in fixed overall supply, a uniform increase in the tax on managerial rents has no impact on production costs; it is only through the misallocation of the factor that costs increase, because of a movement away from the global production frontier for the intermediate good.) Thus, for a country that starts with the higher tax rate among the two countries, an increase in s would increase prices; if it starts with the lower rate, an increase in s would reduce prices. Also, when starting with a higher tax rate, production is higher abroad, so $(e - e^*) < 0$. Hence, $(s - s^*) c_1 \frac{dp_1}{ds}$ is always positive and $(s + s^*) (e - e^*) \frac{d\bar{q}}{ds}$ is always negative. It is more difficult to sign the sum of these terms, which will depend on the functional forms of $h(\cdot)$ and $u(\cdot)$. However, if we consider the special case in which consumption rents are absent (i.e., h' is constant, and $c_1 \frac{dp_1}{ds} = \frac{c_1 \frac{d\bar{q}}{ds}}{h'} = x_1 \frac{d\bar{q}}{ds}$), then (4.26) reduces to $\frac{1}{2} (sf - s^* f^*) \frac{d\bar{q}}{ds}$. This term will be positive if the location of production is relatively insensitive to differences in tax rates (so that $sf - s^* f^*$ is positive when $s > s^*$ and $\frac{d\bar{q}}{ds} > 0$), making a shift away from source-based taxation less likely, with the opposite effect if the location of production is

¹⁴ One can demonstrate that, for a fixed amount of capital used in production, the marginal cost of production f_1 increases if and only if $\frac{f_{12}^*}{f_{11}^*} > \frac{f_{12}}{f_{11}}$. This is easily shown for a range of production functions, including a CES function with decreasing returns to scale in k and m . Details are available upon request.

relatively sensitive to differences in tax rates.

For the general case with transfer-pricing manipulation, (4.24) may be rewritten as:

$$(4.24'') \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 + \bar{q}(e - e^*) - k}{2} \\
+ \frac{1}{2} \left[(1 - s^*) c_1^* \frac{dp_1^*}{ds} - (1 - s) c_1 \frac{dp_1}{ds} + (s + s^*)(e - e^*) \frac{d\bar{q}}{ds} \right] \\
+ \frac{(q - \bar{q})(e - e^*)}{2} + \frac{(s + s^*)}{2} (q - \bar{q}) \left(\frac{d(e - e^*)}{ds} \right) + (s + s^*) \frac{(e - e^*)}{2} \frac{d(q - \bar{q})}{ds}$$

Compared to the case where marginal cost transfer pricing was assumed, we now have three new terms, in the third line. Together, these terms equal

$$(4.27) \quad \frac{d}{ds} \left[\frac{s(q - \bar{q})(e - e^*)}{2} - \frac{s^*(q - \bar{q})(e^* - e)}{2} \right]$$

that is, with respect to an increase in s , the gain from transfer pricing manipulation via increased home tax revenues less the loss from transfer pricing manipulation via increased foreign tax revenues (which reduce the domestic shareholder's income). If this term is positive, the home country will be less likely to reduce s . In terms of the three components in the last line of (4.26), the first adjusts the direct tax exporting benefit of an increase in s for transfer pricing manipulation. The higher is this term, the more an increase in s directly increases tax exporting, making a decrease in s less attractive. The second of these effects corrects the change in tax revenue associated with a change in exports for the fact that revenue is based on the reported transfer price rather than marginal cost. Assuming that net exports fall with an increase in s (i.e., $\frac{d(e - e^*)}{ds} < 0$),¹⁵ this term will be positive if the

¹⁵ We know this is true when the transfer price is set at marginal cost. Proving it for the more general case would require a specification of the nature of transfer pricing behavior.

transfer price is understated. In that case, an increase in s causes a lower revenue loss at home, and a lower revenue gain in the foreign country (which means a smaller drop in the domestic share of foreign profits) than in the absence of the use of transfer pricing, again making a move away from source-based taxation less attractive. The final term accounts for the net change in profit shifting, taking both countries into account, due to the induced change in the transfer price over- or understatement. Without getting into a full discussion of the determinants of transfer pricing, it seems reasonable to assume that the over- or understatement of transfer prices depends on the gap between s and s^* , for a given level of net exports (i.e., $\text{sgn}\left(\frac{d|q-\bar{q}|}{ds}\right) = \text{sgn}(s - s^*)$); that is, transfer pricing manipulation should be positively related to the associated increase in the multinational's after-tax profits.

Table 1 summarizes the signs for these three terms under the four possible regimes under source-based taxation described above.

Table 1. Signs of Transfer Pricing Effects in Expression (4.24")			
Effect:	(1)	(2)	(3)
Case	$\frac{(q - \bar{q})(e - e^*)}{2}$	$(s + s^*) \frac{(q - \bar{q})}{2} \frac{d(e - e^*)}{ds}$	$(s + s^*) \frac{(e - e^*)}{2} \frac{d(q - \bar{q})}{ds}$
A: $s < s^*$ $e > e^*; q > \bar{q}$	(+)(+) +	(+)(-) -	(+)(-) -
B: $s > s^*$ $e < e^*; q > \bar{q}$	(+)(-) -	(+)(-) -	(-)(+) -
C: $s > s^*$ $e > e^*; q < \bar{q}$	(-)(+) -	(-)(-) +	(+)(-) -
D: $s < s^*$ $e < e^*; q < \bar{q}$	(-)(-) +	(-)(-) +	(-)(+) -

Note that the third term is always negative. Increasing s always turns transfer pricing against the home country. In Cases A and D, the low tax country raises its tax rate

and moderates the extent of transfer-pricing manipulation. This lessens the inflation of the value of exports in Case A, and lessens the understatement in the value of imports in Case D, with both effects reducing the home country's tax collections. In Cases B and C, the high tax country raises its tax rate and exacerbates the extent of transfer-pricing manipulation. This raises the inflation of the cost of imports in Case B and deepens the understatement of the value of exports in Case C, in both cases again reducing the home country's tax base.

For the other factors, however, the effect depends on the regime. Factor (1), the direct effect of the tax increase on foreign shareholders, will discourage a reduction in s when the country is a low-tax country (Cases A and D) and have the opposite effect when the country is a high-tax country (Cases B and C), thus tending to push source-based tax rates closer to each other. Factor (2), associated with the revenue effect due to a change in exports, will encourage a reduction in s when the transfer price is initially overstated (Cases A and B), but have the opposite effect in the other two cases. It is only in Case B where all three factors point toward a reduction in the source-based tax. In this case the home country is a high-tax net importer, so the transfer price on its imports will be overstated. This overstatement reduces its tax base and hence the direct tax exporting effect of an increase in s (1), and makes an increase in imports induced by an increase in s more costly (2). Finally, an increase in s worsens net tax exporting by encouraging the multinational to further inflate its transfer price (3).

4.1.3. Local Ownership of fixed factors

Continuing to consider the incentives for a country to switch from source-based to destination-based taxation, we now modify the model, assuming that the rents to the fixed

factors accrue to domestic residents instead of to the multinational. There are two fixed factors implicit in the two production functions $f(k, m)$ and $h(x_1)$. Assuming these factors are owned by domestic residents is equivalent, in our model where there is a representative consumer in each country, to modifying our assumption about the sharing of profits to one where domestic profits attributable to these two factors are received by domestic residents.

With this modification, consider again the issue of whether the home country will wish to shift from a source-based tax to a destination-based tax. In place of equation (4.6), the definition of overall profits, we now have profits of domestic residents, say $\hat{\pi}$:

$$(4.6') \quad \hat{\pi} = (1 - z) \left((1 - s) \left\{ p_1 c_1 - k + q(e - e^*) - \frac{p_1 h' f_2 m}{2} - \frac{(q - \bar{q})(e - e^*)}{2} \right\} + (1 - s^*) \left\{ \frac{p_1^* h^* f_2^* (M - m)}{2} + \frac{(q - \bar{q})(e^* - e)}{2} \right\} \right)$$

where the terms divided by 2 represent the domestic and foreign components of the multinational's remaining profits, from managerial capital and transfer pricing manipulation.¹⁶

Based on (4.6'), the change in domestic income with respect to s is now:

$$(4.28) \quad \begin{aligned} \frac{dY}{ds} = \frac{d\hat{\pi}}{ds} - c_1 \frac{dp_1}{ds} = & -(p_1 c_1 - k) + q(e - e^*) \\ & + (1 - s) \left(p_1 \frac{dc_1}{ds} - \frac{dk}{ds} + q \frac{d(e - e^*)}{ds} + (e - e^*) \frac{dq}{ds} \right) - s c_1 \frac{dp_1}{ds} \\ & - \frac{(1-s)}{2} \frac{d}{ds} (p_1 h' f_2 m) + \frac{p_1 h' f_2 m}{2} + \frac{(1-s^*)}{2} \frac{d}{ds} (p_1^* h^* f_2^* m^*) - \frac{d}{ds} \left(\left(1 - \frac{(s+s^*)}{2} \right) (e - e^*) (q - \bar{q}) \right) \end{aligned}$$

¹⁶ Note that the domestic terms are subtracted to account for the fact that only half of this component of domestic earnings goes to the domestic resident. We must account for profits from transfer pricing manipulation, even though these sum to zero before-tax in the two countries, because there are profits after tax from such activity, and because we do not wish to attribute such profits to domestically owned factors.

Adding the resulting expression for dY/ds to dT/ds as defined in (4.11) yields (after several lines of algebra and using (3.24), the condition relating the marginal returns to managerial skill in the two countries):

$$(4.29) \quad -s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{(e-e^*)(q-\bar{q})}{2} + \frac{(s+s^*)}{2} (q-\bar{q}) \frac{d(e-e^*)}{ds} + \frac{(s+s^*)}{2} (e-e^*) \frac{d(q-\bar{q})}{ds} \\ - \frac{(m-m^*)}{2} \frac{d}{ds} ((1-s)p_1 h' f_2)$$

The first thing to note is that, starting from a symmetric equilibrium, all of the terms on the right-hand side of this expression equal 0, because $(q - \bar{q})$, $(e - e^*)$ and $(m - m^*)$ all equal 0. Thus, unlike in the symmetric equilibrium in which all earnings go to the multinational, the home country will definitely wish to move away from the source-based tax. The explanation is that, in this situation, there are no opportunities for tax exporting. However, this conclusion will no longer hold if the initial equilibrium is asymmetric, due to differences in initial tax rates or preferences. In this more general case, the first three terms on the right-hand side of (4.29) are the same as those in Table 1, representing the same incentives presented by transfer-pricing manipulation. The remaining term in the expression accounts for the effects of a change in s on tax exporting, even under marginal cost pricing. This term may be rewritten as:

$$(4.30) \quad \frac{p_1 h' f_2 m}{2} + \frac{1}{2} \left[(1-s^*) m^* \frac{d}{ds} (\bar{q} f_2^*) - (1-s) m \frac{d}{ds} (\bar{q} f_2) \right]$$

which replaces the terms on the right-hand side of (4.24') when rents are received by domestic factors. Now, only the marginal returns to managerial skill are relevant, but the logic is the same as in the previous case.

4.2. Would the home country adopt a sales tax on good 1?

Thus far we have considered the choice between source-based and destination-based taxation, for which the trade-off is between improved efficiency and potentially reduced tax exporting. We now consider the alternative of a shift toward a sales tax, which as discussed above we can study to understand the effects of a shift to sales-apportioned taxation. For this alternative, we consider only the simple case of a symmetric equilibrium with the multinational's profits equally shared by agents in the two countries, as this will be sufficient to illustrate the key difference between this reform and the one previously considered.

That is, we start with equal source-based taxes ($s = s^*$) and the home country considers introducing a sales tax on good 1 at rate t , as an equal-yield replacement for s . As in the previous case, welfare will increase if and only if

$$(4.31) \quad \frac{dY/dt}{dT/dt} > \frac{dY/ds}{dT/ds}.$$

Because we are starting from the same equilibrium, the changes in Y and T with respect to s are the same as in (4.8) with (4.11'), and the discussion relating to these expressions holds as well. Now, consider the corresponding terms for t . Since

$$(4.32) \quad \pi = (1 - s)((1 - t)p_1c_1 - k) + (1 - s^*)((1 - t^*)p_1^*c_1^* - k^*) + q(e^* - e)(s - s^*),$$

the effect of a change in t on real income, starting at $t = 0$ in the symmetric equilibrium, is therefore (following the same approach as before):

$$(4.33) \quad \frac{dY}{dt} = \frac{1}{2} \frac{d\pi}{dt} - c_1 \frac{dp_1}{dt} = -\frac{1}{2} \left((1 - s)p_1c_1 + (1 + s)c_1 \frac{dp_1}{dt} - (1 - s^*)c_1^* \frac{dp_1^*}{dt} \right)$$

Now consider the changes in T . We again may assume that case A holds, and so we have:

$$(4.34) \quad T = tp_1c_1 + s((1-t)p_1c_1 - k - qx_1 + qf(k, m))$$

Therefore, following the logic used in deriving (4.11'), we obtain

$$(4.35) \quad \frac{dT}{dt} = (1-s)p_1c_1 + s\left(c_1 \frac{dp_1}{dt} + qf_2 \frac{dm}{dt}\right) = (1-s)p_1c_1 + sc_1 \frac{dp_1}{dt},$$

where the last equality comes from the fact that the sales tax does not distort the location of intangible assets, as discussed above. We therefore may express condition (4.31) as:

$$(4.31') \quad \frac{-\frac{1}{2}\left((1-s)p_1c_1 + (1+s)c_1 \frac{dp_1}{dt} - (1-s^*)c_1^* \frac{dp_1^*}{dt}\right)}{(1-s)p_1c_1 + sc_1 \frac{dp_1}{dt}} > \frac{-\frac{1}{2}\left\{(p_1c_1 - k) + (1+s)c_1 \frac{dp_1}{ds} - (1-s^*)c_1^* \frac{dp_1^*}{ds}\right\}}{p_1c_1 - k + s\left(c_1 \frac{dp_1}{ds} + \frac{f_2 dm}{f_1 ds}\right)}$$

Using the fact that we are initially in a symmetric equilibrium and $\frac{dp_1}{ds} = \frac{dp_1^*}{ds}$, this further simplifies to:

$$(4.31'') \quad \frac{-\frac{1}{2}\left((1-s)p_1c_1 + (1+s)c_1 \frac{dp_1}{dt} - (1-s^*)c_1^* \frac{dp_1^*}{dt}\right)}{(1-s)p_1c_1 + sc_1 \frac{dp_1}{dt}} > \frac{-\frac{1}{2}(p_1c_1 - k) - sc_1 \frac{dp_1}{ds}}{p_1c_1 - k + s\left(c_1 \frac{dp_1}{ds} + \frac{f_2 dm}{f_1 ds}\right)}$$

Note, from expressions (3.9) and (3.12), that

$$-p_1 h' + \frac{d(p_1 h')}{dt} = \frac{d(p_1^* h^*)}{dt}$$

Consider first the special case where there are no consumption rents, so that h' is constant and equal across the two countries. Then this expression becomes:

$$-p_1 + \frac{dp_1}{dt} = \frac{dp_1^*}{dt}$$

and (4.31'') becomes:

$$(4.31''') \quad -1 > \frac{-\frac{1}{2}(p_1 c_1 - k) - s c_1 \frac{dp_1}{ds}}{p_1 c_1 - k + s \left(c_1 \frac{dp_1}{ds} + \frac{f_2 dm}{f_1 ds} \right)}$$

The left-hand side of (4.31''') equals 1 because $dY/dt = -dT/dt$ in this case – there is neither a production distortion nor tax exporting. This expression is satisfied if

$$-s \left(\frac{f_2}{f_1} \frac{dm}{ds} \right) > \frac{p_1 c_1 - k}{2}$$

which is the same expression as (4.12'); when there is no tax exporting under the sales tax, the decision is the same as under the destination-based tax.¹⁷ However, if there are consumption rents, then

$$-p_1 + \frac{dp_1}{dt} < \frac{dp_1^*}{dt}$$

since some of the sales tax wedge will show up in a reduced producer price. This reduces in absolute value the numerator of the left-hand side of (4.31'''), making it more likely that the condition will be met (since the overall term is negative); with consumption rents, some of the burden of the sales tax is shifted onto producers, and some of this burden on producers is borne by owners in the other country.

Note that this is different from the case of the destination-based tax because there is no substitution effect away from consumption of good 1 in that case. While the substitution

¹⁷ One might have expected the condition to differ from (4.12') even in this special case, since the sales tax introduces a consumption distortion that is not present under the destination-based tax. However, our experiment here considers the introduction of a small sales tax, starting from an initial value of zero, for which there is no first-order deadweight loss. For a larger tax change, the adoption of a sales tax would presumably be less attractive because of the associated consumption distortion, although the analysis would also be more complicated.

effect results in a distortion in this case, the introduction of a small tax has only second-order deadweight loss but first-order effects on incidence. Thus, for a small shift away from source-based taxation, a sales-based approach may be preferable to a destination-based tax, as the more favorable incidence achieved via a reduction in the pricing power of the multinational may outweigh the small distortions to domestic consumption. But this trade-off would presumably be less favorable for a larger tax shift, and also does not account for the additional distortions of sales-apportioned taxes not in the model, already discussed above.

5. Conclusions

This paper models the effects of alternative forms of consumption-type taxes in a two-country model with trade of semi-finished goods and mobile factors of production. In our base case, we consider a representative multinational that produces and sells in each of the two countries and allocates capital and managerial skill between the two countries for production. There are three sources of rents for the multinational: a fixed factor in each country of basic production; managerial skill, owned by the company, and mobile between the two countries; and a fixed factor in the country of consumption, associated with preparing the semi-finished good for the local market. We consider three main forms of cash-flow taxation, all of which would be equivalent in a closed economy: a cash-flow tax levied on the multinational on a source basis, the equivalent tax levied on a destination basis, and one whose base is allocated using sales-only formula apportionment (the effects of which can be studied by analyzing a sales tax levied on the good produced by the

multinational.) We describe the forms of distortion to production and consumption generated by these taxes.

We investigate whether there is an incentive for a national government to move away from an equilibrium in which both countries use only the source-based tax. We show that the government faces a trade-off. On the one hand, movement away from a source-based tax to a destination-based tax reduces distortions and improves welfare. This result may be reinforced by the presence of transfer-pricing manipulation by firms, either by pushing a high-tax country to lower its tax to reduce the incentives for such manipulation (from which it suffers), or by leading a low-tax country to lower its tax still further to encourage an expansion of such manipulation (from which it benefits). On the other hand, the source-based tax is partially incident on the owners of the multinational; since some of them may be non-residents, the tax can improve the welfare of domestic residents, if its distortions are small relative to this shifting. For a shift to the sales-apportioned tax, the calculus is somewhat more complicated, as the apportioned tax may also partially be shifted to non-residents, but also introduces various distortions (not all of which are incorporated in our analysis) absent under the destination-based tax.

However, the potential attractiveness of the source-based tax is reduced if the returns to fixed production factors in each country are captured by domestic residents, so that the world-wide rent of the multinational is due solely to its ownership of managerial skill. In this case, in a symmetric equilibrium the source-based tax is incident only on domestic residents, and so its main potential benefit for the national government is no longer present. This tax does, however, continue to distort the choice of where to locate mobile managerial skill. This distortion reduces welfare, and can be reduced by a substitution away from the source-based tax in the direction of the destination-based tax, or a sales (or sales-apportioned) tax.

REFERENCES

- Auerbach, A.J. (1997) "The Future of Fundamental Tax Reform", *American Economic Review* 87, 143-146.
- Auerbach, A.J. (2011) "Consumption Tax Options for California", Technical Appendix, Public Policy Institute of California Report, June.
- Avi-Yonah, R. (2000) "Globalization, Tax Competition, and the Fiscal Crisis of the Welfare State", *Harvard Law Review*, 113, 1573-1676.
- Avi-Yonah, R. and K. Clausing (2008) "Reforming Corporate Taxation in a Global Economy: A Proposal to Adopt Formulary Apportionment" in Jason Furman and Jason E. Bordoff, eds. *Path to Prosperity: Hamilton Project Ideas on Income Security, Education, and Taxes*, 319-344.
- Bradford, D. (2003) "The X Tax in the World Economy", *CEPS Working Paper 93*, Princeton.
- Devereux, M.P. and S.R. Bond (2002) "Cash Flow Taxes in an Open Economy", *CEPR Discussion Paper 3401*.
- Gordon, R.H. (1986) "Taxation of Investment and Savings in a World Economy", *American Economic Review* 76, 1086-1102.
- Gordon, R.H. and J.D. Wilson (1986) "An Examination of Multijurisdictional Corporate Income Taxation under Formula Apportionment", *Econometrica* 54, 1357-1373.
- Grubert, H. and T. S. Newlon (1997) "Taxing Consumption in a Global Economy", Washington D.C.: American Enterprise Institute.
- Keen, M. and S Lahiri (1998) "The Comparison between Destination and Origin Principles under Imperfect Competition," *Journal of International Economics* 45, 323-350.
- Lockwood, B. (1993) "Commodity Tax Competition Under Destination and Origin Principles" *Journal of Public Economics* 53, 141-162.
- Lockwood, B. (2001) "Tax Competition and Tax Co-ordination under Destination and Origin Principles: a Synthesis", *Journal of Public Economics* 81, 279-319.
- Meade, J. et al. (1978) *The Structure and Reform of Direct Taxation*, London: Allen and Unwin.