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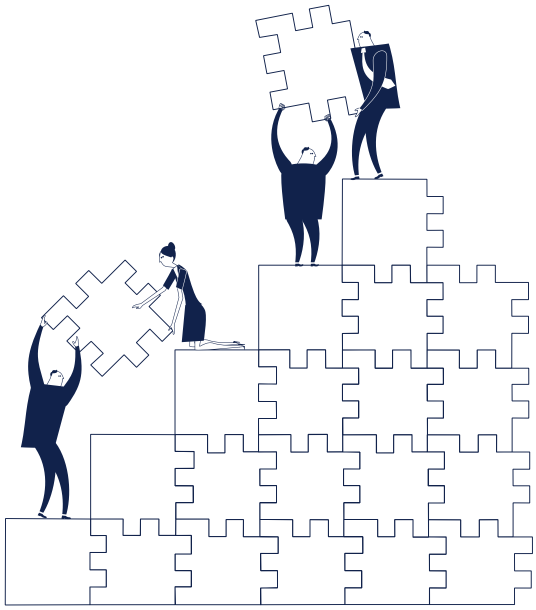

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Abstract

We model the effects of cash flow taxes on company profit 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 trade-offs 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 behaviour, 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 rate of a source-based capital income tax in a small open economy is zero (see Gordon, 1986). Imposing a positive tax rate raises the required pre-tax rate of return in that location, reducing the domestic capital stock and in turn creating an excess burden, borne by domestic residents, which could be avoided by taxing immobile factors directly.

In light of these effects, an alternative to a tax on all business income is a cash-flow tax that falls only on business profit or economic rent. This paper investigates the effects of different types of cash-flow taxes on factor allocation, production and consumption in a two-country framework. Our particular interest is in three versions of the business cash-flow tax that differ in how profit is allocated across the two countries.[1] We analyze a cash-flow tax in a conventional source-based setting and under two alternatives: where aggregate profit is allocated by an apportionment factor based on the location of sales;[2] and a "destination" tax which, like a VAT, exempts exports but taxes imports. We explore and compare the efficiency properties of each of these forms of taxation. We show that even when capital income is excluded from the tax base, so that the tax is based only on profit or economic rent, there are many potential distortions.

International tax reform is likely to occur only when it is in the national interest of individual governments. So, in considering reform either in the direction of a destination-

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[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.

[2] This factor is increasingly used for the allocation of profit for tax purposes between US states, and forms part of the European Commission's proposals for a formula allocation in the EU.

based tax or of a sales-apportioned tax, it is useful to consider whether a unilateral deviation from the conventional source-based tax system would be beneficial for the adopting country. We therefore also investigate whether, starting from the standard form of taxation for the international allocation of profit, the source-based tax, countries have an incentive to switch at least part of their tax system to one of the other two forms.

For our analysis, we construct a model that incorporates important elements of multinational enterprises, including firm-specific factors of production, intangible assets, international location of activities and broad ownership. In this model, a representative multinational company takes all prices as given, and is owned equally by two representative consumers, one in each country. The company has a production plant in each country that supplies an intermediate good to a second plant in either or both countries. The intermediate good is completed and turned into the final good in the country in which it is sold and consumed. This second process may reflect the fact that the final good differs between countries depending on local conditions – for example, a car must be prepared as right- or left-hand drive – or it may reflect advertising, distribution, and other activities that take place in the proximity of consumption.

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 the 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 also think of it as a stock of intangible assets. The profit generated from access to this asset is mobile between the two countries.

Note that we do not rely on imperfect competition to generate profit, for two reasons. Primarily, our main goal is to compare the welfare effects of the alternative tax bases. This comparison is clearer in a model in which there are no inefficiencies in the absence of taxation, which is generally not the case in the presence of imperfect competition. Second, allowing instead for profit to be associated with production taking place in each country naturally introduces a transfer of the intermediate good between countries. This permits analysis of the incentives for transfer prices to be manipulated under the alternative tax bases.

Within our framework, even taxes on pure profits can affect economic behaviour. 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 foreign, 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.[3] This is consistent with empirical evidence that discrete location choices and flows of foreign direct investment depend on an average effective tax rate which – unlike a marginal effective tax rate - is non-zero in the presence of a cash flow tax.[4]

By contrast, a destination-based tax implemented in both countries along the lines of a VAT (but with labour 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. An apportionment system based on sales would also have the property of not distorting the location of production. But in contrast to the destination-based tax, it would distort consumption patterns. If the home country has the higher tax rate, for example, then the multinational has an incentive to reduce sales at home and raise sales abroad, thereby shifting the location of profit for tax purposes.

A national government considering whether to switch from a source-based cash-flow tax to either of the other two forms of taxation needs to consider two factors. One is the welfare costs borne at home of the distortions induced by each form of taxation. The second is incidence. The source-based cash flow tax does have an attractive property for a national government: the incidence of the tax falls to an extent on the owners of the company, some of whom may be non-resident. In a non-cooperative setting, then, there is

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[3] 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. An earlier unpublished paper, co-authored by one of the authors of this paper (Bond and Devereux, 2002) compares the properties of source- and destination-based taxes when the company locates its production in only one country. This paper goes beyond the model used in the earlier paper in several directions, including specifying carefully alternative sources of the firm's profit and explicitly modeling transfers between different parts of the company located in different countries. This paper also explicitly considers the welfare effects of a switch from a source-based tax.

[4] See Devereux and Griffith (1998) and the meta analysis of de Mooij and Ederveen (2008).

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.

In the general case, in considering a switch to a destination base, the government faces a tradeoff between the distortions imposed by the source-based tax and the benefit of taxing non-residents under the source-based tax. However, this benefit of the source-based tax may not be present in an alternative framework which we also 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. The same factors arise in considering the switch from a source-based tax to a sales-apportioned tax. However, both features of the source-based tax – the deadweight costs arising from distortions, and the exporting of the tax to non-residents – may also arise in the case of the sales-apportioned tax. The case for switching therefore depends on the relative size of these two factors.

These differences between source-based and destination-based taxes may appear to be at odds with several claims in the literature regarding the equivalence of destination and source-based taxes, but the apparent inconsistency simply reflects differences in assumptions. As an illustration, in the version of our model in which the rent accruing to fixed factors is captured by local residents, the only remaining distortion (aside from explicit transfer pricing manipulation) is in the choice of where to locate managerial skill. That, too, 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), Avi-Yonah (2000), Grubert and Newlon (1997) and others, resulting in the claim that destination-based and source-based consumption taxes are equivalent. We show in this paper the nature of the assumptions that need to be made for such an equivalence to hold.[5]

The remainder of the paper is organised 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

[5] In that respect, our analysis 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 synthesised 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 imperfect competition destroys this equivalence.

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.

2. The Model

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

$$U = u(c_1) + c_2 + v(g); \qquad U^* = u^*(c_1) + c_2^* + v(g^*) \tag{2.1}$$

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 characterised 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

$$K = (1 - c_2 - g) + (1 - c_2^* - g^*) = k + k^* \tag{2.2}$$

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 labour, 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,

$$M = m + m^{*} \tag{2.3}$$

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. They key, for our purposes, is that its location is not fixed in either jurisdiction.[6]

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

$$x_1 + x_1^{*} = f(k,m) + f(k^{*},m^{*}) \tag{2.4}$$

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.

[6] However, in order to allow this source of rent to be mobile between countries, we do assume that this asset cannot be used simultaneously in both countries – i.e., it has no public good aspects within the firm. This corresponds to the fixed management capacity approach in the model of Becker and Fuest (2010), for example. Becker and Fuest also consider the case in which management is a public good within the firm, and Devereux et al (2013) consider a more flexible approach.

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.[7] 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, $h(\cdot)$,

$$c_1 = h(x_1)\,;\, c_1^* = h(x_1^*) \tag{2.5}$$

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.[8] 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 factor; the return to managerial skill is mobile, and depends on the location of the managerial skill itself; and

[7] 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.

[8] 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.

the return to the fixed factor in final production is located in the country of consumption. These differences in location are important in modelling 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 4 we consider the incentives to deviate from a common tax base.

3. Alternative Tax Regimes

We consider three variants of taxes on cash flows, which fall only on pure profits and exempt from tax the normal return to capital, K.[9] While much of the literature on multinationals has focused on capital taxation, our focus here is on the taxation of rents.

It is useful to begin by presenting the equilibrium conditions in the absence of taxes. Letting good 2 be the numeraire commodity, the conditions for utility maximization are:

$$(3.1) \qquad u'(c_1) = \frac{p_1}{p_2} = p_1; \qquad u^{*'}(c_1^*) = \frac{p_1^*}{p_2^*} = p_1^*,$$

and profits of the multinational are:

$$(3.2) \qquad \pi = p_1 c_1 + p_1^* c_1^* - K$$

$$= u'(c_1)h(x_1) + u^{*'}(c_1^*)h\{f(k,m) + f(K-k, M-m) - x_1\} - K.$$

Maximizing profit with respect to k, m, K, and x_1 yields the firm's first-order conditions:

$$(3.3) \qquad k: \quad f_1(k,m) = f_1(k^*, m^*)$$

$$(3.4) \qquad m: \quad f_2(k,m) = f_2(k^*, m^*)$$

[9] For all three taxes, we abstract from issues concerning debt and the treatment of interest, by implicitly assuming the multinational is equity financed.

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

(3.6) x_1: $u^{'}(c_1)h'(x_1) = u^{*'}(c_1^*)h^{'}(x_1^*)$

Conditions (3.3) and (3.4) 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 (3.5) calls for setting marginal revenue equal to marginal cost. Condition (3.6) implies that marginal revenues, in this case equal to marginal consumer valuation, should be independent of consumption location.

Finally, the household budget constraint becomes (with the equivalent abroad):

(3.7) $u^{'}(c_1)c_1 + c_2 = 1 + \frac{(u^{'}(c_1)c_1 + u^{*'}(c_1^*)c_1^* - K)}{2}$

3.1. Source-based cash-flow tax

We now consider a cash-flow tax allocated using the source principle that is the standard approach of the existing international tax system. 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 (3.1) . We assume that the final level of production, turning x into the final good 1, takes place in the country of consumption. 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 the unfinished 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:

(3.8) $$\pi = (p_1c_1 - k)(1-t) + (p_1^*c_1^* - k^*)(1-t^*) + (q^*e^* - qe)(t - t^*).$$

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, so that the firm can choose where to produce the unfinished good 1 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. As we discuss below, 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 $\pi_B = (1-t)\{p_1h(x_1) - qx_1\}$. Plant A chooses k to maximise its profit and plant B chooses $x_1 = f(k,m)$ to maximise 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 $p_1h^{'}(x_1)f_1(\hat{k},m) = 1$? 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 cash- flow tax analyzed here, so in addition we have as a benchmark $q^* = 1/f_1(K-k, M-m)$.

The multinational may exploit the absence of an arms' length price to manipulate its transfer prices in order to shift profit between the two countries. But even with 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 (3.8), 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 maximise q. In the last two cases, the high-tax country is exporting, and the firm will wish to minimise q.

As modeling the firm's choice of its transfer price is potentially quite complex, we analyze behaviour under the simplifying assumption that there is some range of observed comparable prices, exogenous from the firm's perspective, which would be acceptable to the tax authorities of both countries. The firm can choose prices within this range without cost. However, beyond this range, one of the tax authorities would challenge the choice; this would require the firm to produce additional documentation to justify its chosen price, and may also require negotiation between the two tax authorities.[10] This would introduce high costs for the firm that it would prefer to avoid, so that the firm will never find it optimal to choose a transfer price outside the observed range. That is, we assume that the

[10] Becker and Davies (2014) develop a more detailed model of transfer pricing based on this approach.

firm chooses the transfer price $q \epsilon [q_L, q_u]$ that maximises profits. Specifically, in order to shift profit to the lower taxed country, in cases A and B the firm has an incentive to choose a high $q = q_u$ and in cases C and D it has an incentive to choose a low $q = q_L$.

Note also that in all four cases, $e^* - e = x_1 - f(k,m)$. This generates general first order conditions as follows:

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

(3.10) K: $p_1^* h^{*\prime} = \frac{1}{f_1^*}$

(3.11) k: $p_1^* h^{*\prime}(f_1 - f_1^*)(1-t^*) + (1 - q f_1)(t - t^*) = 0$

(3.12) m: $p_1^* h^{*\prime}(f_2 - f_2^*)(1-t^*) - q f_2(t - t^*) = 0$

where the value of q depends on the case, as described above, and where for ease of notation we have dropped the arguments for the functions $h(.)$ and $f(.)$ and replaced the derivatives of the utility functions with price terms. In the limiting situation where the firm's latitude for transfer-pricing manipulation completely vanishes and the interval $[q_L, q_u]$ collapses to the firm's actual marginal cost transfer price (which will then turn out to be equal across the two countries, i.e., $q = \frac{1}{f_1^*} = \frac{1}{f_1}$), these conditions simplify to:

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

(3.10') $p_1^* h^{*\prime} = \frac{1}{f_1^*}$

(3.11') $f_1 = f_1^*$

(3.12') $f_2(1-t) = f_2^*(1-t^*)$

In this instance, 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.[11] 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, though, 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 maximise q. From (3.11), $q = q_u > \frac{1}{f_1}$ 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 minimise q. From (3.11), $q = q_L < \frac{1}{f_1}$ implies that $f_1 < f_1^*$. That is, with transfer pricing manipulation, production is again shifted 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 $q < \frac{1}{f_1}$ would reduce $f_2 - f_2^* > 0$, again pushing more intellectual property to the home country. Thus, transfer-pricing

[11] The same is true, implicitly, of location-specific rents in the first stage of production.

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 (3.12'), 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. The capital-allocation decision is clearly distorted by transfer pricing manipulation, since if the transfer price were equal to marginal cost, then it would be undistorted (see expression (3.11')). However, 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 (3.12').

3.2. Cash-flow 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 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 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). As already discussed, we consider the case in which the tax base itself is cash flow.

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.[12] Consequently, the equilibrium competitive price for good 2 will still be 1, and the utility maximization conditions in expression (3.1) still holds. Post-tax profits are:

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

[12] 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 (3.15). See Auerbach (2011) for further discussion of these distortions.

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

where π^G equals pre-tax profits. Hence, the term $\left(f_1 - f_1^*\right)$ must equal 0 and (3.3) still holds; likewise, from a similar first-order condition with respect to *m*, so does condition (3.4), so there is still production efficiency.

As shown in the Appendix, the condition with respect to *K* yields:

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

where we have here used the conditions for production efficiency. A similar condition for the home country follows from the first-order condition for x_1. 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.

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.

3.3. 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. More precisely, we consider the same tax base as the source-based tax analyzed in Section 3.1, but with the difference that we add border adjustments along the lines of VAT, so that exports are not taxed, but imports are taxed.

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:

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

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:

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

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. Therefore, (3.18) $$u'(c_1) = \frac{p_1}{p_2} = (1-t)p_1; \qquad u^{*'}(c_1^*) = \frac{p_1^*}{p_2^*} = (1-t^*)p_1^*.$$

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:

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

This expression is the same as (3.2) in the absence of tax, which implies that the tax has no effect on firm behaviour.

The household budget constraint (with an equivalent condition for the foreign country) is:

(3.20) $$p_1 c_1 + p_2 c_2 = w + \frac{u'(c_1)c_1 + u^{*'}(c_1^*)c_1^* - K}{2}$$

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

This expression makes it clear that the destination-based tax is equivalent to a tax on the pure profits received by domestic residents. 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 labour from the tax base, unlike a standard VAT. With a labour-leisure trade-off, of course, a uniform VAT on market consumption expenditures would distort labour supply.

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. We assume that each country chooses its tax policy taking 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-apportioned cash-flow tax, beginning with the first because of its simpler impacts. 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 maximise the representative resident's utility, as given in expression (2.1), with respect to the tax rate, t, the first-order condition will be that the derivative of the resident's indirect utility function with respect to t equals 0. That is,

$$\text{(4.1)} \qquad \frac{dy}{dt} - c_1\frac{dp_1}{dt} - c_2\frac{dp_2}{dt} + v'(g)\frac{dT}{dt} = 0 \Rightarrow g = v'^{-1}\left(-\frac{dY/dt}{dT/dt}\right)$$

where y is the resident's income, equal to half of the multinational's after-tax profits, $\pi/2$ and

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

may be interpreted as 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?

We begin by considering a marginal switch from a source-based tax to a destination-based tax. 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 pure profits tax, at rate z, on the home country's share of profits (see expression (3.20)). In this case, the tax does not affect p_2 and hence expression (3.1) holds.

Let ε be the experiment of reducing s and increasing z. 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:

$$(4.3) \qquad \frac{dT}{ds}\frac{ds}{d\varepsilon} = \frac{dT}{dz}\frac{dz}{d\varepsilon}$$

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

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

which requires the marginal cost of public funds to be lower for the destination-based tax than the source-based tax.

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

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

since the price of good 2 equals 1 under both tax systems. In this case, $p_1 = u'(c_1)$ Since an increase in z is nondistortionary, its only behavioural impact will be to reduce g and c_2; prices, consumption of good 1 and capital are all unaffected. As a result,

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

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.

To identify the effects of a change in the source-based tax, we first specify the profit of the multinational as

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

We evaluate the change in this term at $z = 0$. The effect of a change in the source-based tax rate on real income is then:

$$\text{(4.8)} \qquad \frac{dY}{ds} = \frac{1}{2}\left\{-p_1c_1 + k - q(e-e^*) + (1-s)c_1\frac{dp_1}{ds} + (1-s^*)c_1^*\frac{dp_1^*}{ds}\right\} - c_1\frac{dp_1}{ds},$$

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

$$\text{(4.9)} \qquad T = z\frac{\pi}{2} + s(p_1c_1 - k + q(e-e^*)).$$

Using $c_1 = h(x_1), e - e^* = f(k,m) - x_1$ and $\frac{df}{ds} = f_1\frac{dk}{ds} + f_2\frac{dm}{ds}$, this implies that

$$\text{(4.10)} \qquad \frac{dT}{ds} = p_1c_1 - k + q(e-e^*) + s\left(c_1\frac{dp_1}{ds} + \left(p_1h' - q\right)\frac{dx_1}{ds} - (1-qf_1)\frac{dk}{ds} + qf_2\frac{dm}{ds}\right)$$

Combining these expressions, rearranging and using $p_1h' = 1/f_1$ (from (3.10)[13]), we can write the condition for welfare improvement as:

$$\text{(4.11)} \quad -s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right) - s\left(q - \frac{1}{f_1}\right)\left(\frac{d(e-e^*)}{ds}\right) > \frac{p_1c_1 + q(e-e^*) - k}{2} + \frac{1}{2}\left[(1-s^*)c_1^*\frac{dp_1^*}{ds} - (1-s)c_1\frac{dp_1}{ds}\right]$$

To interpret this condition, note first that the terms on the right-hand side are divided by two, reflecting the division of profits between the two countries. Both terms account for tax exporting under source-based taxation. The first of these terms is the direct incidence on foreign shareholders of a tax on domestic profits (via an increased tax on the domestic tax base), while the second accounts for further shifting associated with changes in domestic and foreign output prices induced by the change in *s*. These terms in brackets have different signs, because an increase in the foreign consumer price benefits domestic residents by increasing their share of world-wide profits, while an increase in the domestic consumer price lowers the real income of domestic consumers but is only half offset by the domestic share of increased profits. As there is no tax shifting under the destination-based

[13] While (3.10) refers to the foreign country, symmetry implies that it holds for the home country as well.

tax, which is borne by domestic consumers, these right-hand-side terms account for the tax exporting forgone in shifting from a source-based tax to a destination-based tax.

The terms on the left-hand side of (4.11) are associated with the distortions of source-based taxation that a shift to a destination-based tax may lessen. The first of these terms, which will be positive, represents the increased revenue generated from attracting managerial capital by reducing the source-based tax. The second of these terms adjusts 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., $\frac{d(e-e^*)}{ds} < 0$),[14] this term will also be positive (making adoption of the tax reform more likely) if the transfer price is overstated, i.e., in the "normal" cases A and B in which the low-tax country is the exporting country. In case A, the low-tax domestic country, by lowering its source-based tax, increases its gain via transfer pricing by expanding its exports. In Case B, the high-tax domestic country, by lowering its source-based tax, reduces its loss via transfer pricing by shrinking its imports. As discussed in the introduction, one may think of the incentive to shift managerial capital as reflecting a failure of transfer pricing, in the sense that moving the factor from one country to the other requires no payment for the factor from the country to which the factor moves to the other country. Under this interpretation, both factors on the left hand-side of expression (4.11) equal a transfer-pricing wedge (respectively, the marginal revenue product of managerial capital, since $1/f_1$ is the arm's length price of the intermediate good, and the transfer-pricing gap associated with trade in intermediate goods) multiplied by the applicable tax

[14] This is shown in the Appendix for the case where the transfer price is set at marginal cost, preferences are the same in the two countries and the tax rates are initially equal.

rate, *s*, and the associated behavioural response to the tax reform being considered. Thus, both terms take the familiar form of marginal deadweight loss expressions, equal to a tax wedge multiplied by the change in quantity to which the wedge applies, although in this case the distortions are measured in terms of the welfare of the home country only.

Note that in cases C and D, where the high-tax country exports, the second term on the left-hand side of (4.11) will be negative, still assuming that net exports fall with an increase in *s*, and hence the presence of transfer-pricing manipulation *reduces* the country's likelihood of shifting away from a source-based tax. The intuition for this result is that, as discussed in Section 3, firms will export more when they can manipulate transfer prices to take advantage of a tax differential, even when exporting from a high-tax country. This promotes production in the high-tax country, and hence lessens the real behavioural response away from production there that would otherwise occur. Thus, for a high-tax exporting country (case C) or a low-tax importing country (case D) reducing its source-based tax, there will be there will be less of a gain in domestic production activity,

For special cases, expression (4.11) can be simplified further. For example, under marginal-cost transfer pricing, with common preferences in the two countries, and initially equal tax rates so that $s - s^* = e - e^* = 0$, it is shown in the Appendix that consumer prices and good-1 consumption levels will be the same in the two countries, so that the expression reduces to:

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

Both terms in (4.12) are positive, so there is a straightforward trade-off between the benefit of attracting managerial capital and the direct tax exporting effect. But even in this case, we have no definitive result about whether the inequality holds. *Ceteris paribus*, though, a higher initial value of s would make the result more likely, with the nonlinearity of the efficiency term causing this effect to dominate the tax exporting term.

4.1.1. 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 rents to fixed factors accrue to domestic residents instead of to the multinational. There are two fixed factors implicit in the production functions $f(k,m)$ and $h(x_1)$. To make these explicit, we can rewrite the intermediate production function $f(\cdot)$ and the final production function $h(\cdot)$ each as having an additional argument, e.g., $f(k,m,r)$ and $h(x_1,\rho)$, with constant returns to scale and (assuming the multinational is a price-taker with respect to these fixed factors) with the corresponding competitive returns to these arguments denoted by q_r and q_ρ in the home country and likewise with an asterisk in the foreign country.

With these additional factors taken into account, the firm's objective is to maximise profits as given in expression (3.8) minus $\left(q_r r + q_\rho \rho\right)(1-s) + \left(q_r^* r^* + q_\rho^* \rho^*\right)(1-s^*)$, assuming that the fixed-factor rents are taxed at the same tax rate in each country as the multinational is. With this modification of its objective, the firm's first-order conditions given in (3.9)-(3.12) are unchanged, and there are four new first-order conditions for the use of each of the fixed factors:

(4.13) ρ: $\quad p_1 h_2 = q_\rho$

(4.14) ρ^*: $\quad p_1^* h_2^* = q_\rho^*$

(4.15) r: $\quad p_1^* h^{*'} f_3 (1-s^*) - q f_3 (s-s^*) = q_r(1-s)$

(4.16) r^*: $\quad p_1^* h^{*'} f_3^* = q_r^*$

where $h_2 = c_1 - h' x_1$ and $f_3 = f - f_1 k - f_2 m$ (and similarly for the foreign country). Note that by the symmetry of the set-up, it also follows that $p_1 h' f_3 = q_r$. In equilibrium, of course, the four fixed factor prices will be determined by the market clearing conditions that demand for each of the fixed factors equals its unit supply.

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 (4.7), the definition of overall profits, we now have income of domestic residents, say $\frac{\hat{\pi}}{2}$, where

$$(4.17) \qquad \hat{\pi} = (1 - z)[\pi + D(1 - s) - F(1 - s^*)]$$

where π is as defined in expression (3.8), $D = q_r r + q_\rho \rho$ and $F = q_r^* r^* + q_\rho^* \rho^*$ (and each rent quantity equals 1 in equilibrium).

Based on (4.17), the change in domestic income with respect to s is now:

$$(4.18) \qquad \frac{dY}{ds} = \frac{1}{2}\frac{d\hat{\pi}}{ds} - c_1 \frac{dp_1}{ds} = \frac{1}{2}\left\{\begin{matrix} -p_1 c_1 + k - q(e - e^*) - D + \\ (1 - s)\left(c_1 \frac{dp_1}{ds} + \frac{dD}{ds}\right) + (1 - s^*)\left(c_1^* \frac{dp_1^*}{ds} - \frac{dF}{ds}\right) \end{matrix}\right\} - c_1 \frac{dp_1}{ds}$$

where the remaining terms vanish due to the envelope theorem, from the firm's maximization of $\pi - D(1 - s) - F(1 - s^*)$. Adding this expression to dT/ds as defined in (4.10) yields, after some algebra (shown in the Appendix):

$$(4.19) \quad -s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right) - s(q - \bar{q})\left(\frac{d(e - e^*)}{ds}\right) > \frac{p_1 c_1 + q(e - e^*) - k - D}{2}$$
$$+ \frac{1}{2}\left[(1 - s^*)\left(c_1^* \frac{dp_1^*}{ds} - \frac{dF}{ds}\right) - (1 - s)\left(c_1 \frac{dp_1}{ds} - \frac{dD}{ds}\right)\right]$$

$$= \frac{\left[(q-\bar{q})(e-e^*)+\bar{q}f_2 m-(1-s^*)\left((e^*-e)\frac{d\bar{q}^*}{ds}-m^*\frac{d(\bar{q}^* f_2^*)}{ds}\right)+(1-s)\left((e-e^*)\frac{d\bar{q}}{ds}-m\frac{d(\bar{q}f_2)}{ds}\right)\right]}{2}$$

where $\bar{q} = 1/f_1$ is the marginal cost of the intermediate good produced at home (likewise for $\bar{q}^*$ abroad) and the last substitution uses (3.10) and the facts that $D = q_r + q_\rho = p_1 c_1 + \bar{q}(e - e^*) - k - \bar{q} f_2 m$ and $F = q_r^* + q_\rho^* = p_1^* c_1^* + \bar{q}^*(e^* - e) - k^* - \bar{q}^* f_2^* m^*$.

Comparing expression (4.19) to (4.11), we see that the left-hand sides of the expressions, representing efficiency effects, are the same. But the tax-shifting incidence terms on the right-hand side of (4.19) relate only to the components of profit still accruing to the multinational, the returns to managerial skill and transfer-pricing manipulation.

As before, the expression simplifies for special cases. For example, starting at a symmetric equilibrium, with $s - s^* = e - e^* = 0$ and with marginal cost transfer pricing (as shown in the Appendix), (4.19) reduces to

(4.20) $$-s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right) > 0$$

That is, in this case all of the terms on the right-hand side of (4.19) vanish. 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. In this situation, with a smaller component of earnings going to the multinational and its shareholders worldwide, there are no opportunities for tax exporting because there are no domestic production or consumption rents accruing to foreigners.

4.2. Would the home country adopt a sales-apportioned tax?

Thus far we have considered the choice between source-based and destination-based taxation, for which the trade-off is between improved incentives and potentially reduced tax exporting. We now consider the alternative of a shift from a source-based tax toward sales-apportioned taxation. For this alternative, we consider only the simple case of a symmetric initial equilibrium (common preferences and equal source-based taxes, $s = s^*$), with marginal cost transfer pricing and all earnings accruing to the multinational's shareholders; this will suffice to illustrate the key difference between this reform and the one previously considered.

From the previous logic, home-country welfare will increase with the introduction of a sales tax on good 1 at rate *t*, as an equal-yield replacement for *s*, if and only if:

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

Because we are starting from a symmetric equilibrium with marginal-cost transfer pricing, the changes in *Y* and *T* with respect to a source-based tax at rate *s*, (4.8) and (4.10), simplify to:

(4.8') $$\frac{dY}{ds} = -\frac{1}{2}(p_1 c_1 - k) - s c_1 \frac{dp_1}{ds}$$

and

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

where (4.8’) uses the result that, under these conditions, $\frac{dp_1}{ds} = \frac{dp_1^*}{ds}$, as set out in the Appendix. Now, consider the corresponding terms for t. Where a is the apportionment share defined in (3.13), after-tax multinational profits are:

$$\pi = (1 - ta - t^*(1 - a)) \left\{ \begin{matrix} (1 - s)(p_1 c_1 - k) \\ +(1 - s^*)(p_1^* c_1^* - k^*) + q(e^* - e)(s - s^*) \end{matrix} \right\}. \tag{4.22}$$

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):

$$\frac{dY}{dt} = \frac{1}{2}\frac{d\pi}{dt} - c_1 \frac{dp_1}{dt} = -\frac{1}{2}\left((1 - s)(p_1 c_1 - k) + (1 + s)c_1 \frac{dp_1}{dt} - (1 - s^*)c_1^* \frac{dp_1^*}{dt}\right) \tag{4.23}$$

Now consider the changes in T. Using the definition of net exports, we have:

$$T = at\big((1 - s)(p_1 c_1 - k) + (1 - s^*)(p_1^* c_1^* - k^*)\big) \\ +s\big(p_1 c_1 - k - q x_1 + q f(k, m)\big) \tag{4.24}$$

Following the logic used in deriving (4.10’), we obtain:

$$\frac{dT}{dt} = (1 - s)(p_1 c_1 - k) + s\left(c_1 \frac{dp_1}{dt} + q f_2 \frac{dm}{dt}\right) = (1 - s)(p_1 c_1 - k) + s c_1 \frac{dp_1}{dt}, \tag{4.25}$$

where the last equality comes from the fact, discussed above, that the sales-apportioned tax does not distort the location of intangible assets. We therefore may express (4.21) as:

$$\frac{-\frac{1}{2}\left((1-s)(p_1 c_1 - k) + (1+s)c_1 \frac{dp_1}{dt} - (1-s)c_1 \frac{dp_1^*}{dt}\right)}{(1-s)(p_1 c_1 - k) + s c_1 \frac{dp_1}{dt}} > \frac{-\frac{1}{2}(p_1 c_1 - k) - s c_1 \frac{dp_1}{ds}}{p_1 c_1 - k + s\left(c_1 \frac{dp_1}{ds} + \frac{f_2}{f_1}\frac{dm}{ds}\right)} \tag{4.26}$$

To evaluate this expression, we use expression (3.15) for the home and foreign country, from which we obtain, at t = 0,

$$(4.27) \qquad -\frac{(p_1c_1-k)p_1h'}{p_1c_1}+\frac{d(p_1h')}{dt}=\frac{d(p_1^*h^{*'})}{dt}$$

Consider first the special case with no consumption rents, i.e., h' is constant and equal across the two countries. Then (4.27) reduces to $-\frac{(p_1c_1-k)p_1}{p_1c_1}+\frac{dp_1}{dt}=\frac{dp_1^*}{dt}$ and (4.26) becomes:

$$(4.28) \qquad -1>\frac{-\frac{1}{2}(p_1c_1-k)-sc_1\frac{dp_1}{ds}}{p_1c_1-k+s\left(c_1\frac{dp_1}{ds}+\frac{f_2}{f_1}\frac{dm}{ds}\right)}$$

The left-hand side of (4.28) equals 1 because $dY/dt = -dT/dt$ in this case – there is neither a production distortion nor tax exporting. This expression is satisfied if and only if

$$(4.29) \qquad -s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right)>\frac{p_1c_1-k}{2}$$

which is the same expression as (4.12) for a switch to destination-based tax starting from the same initial equilibrium; when there is no tax exporting under the sales-apportioned tax, the decision is the same as under the destination-based tax.[15]

However, if there are consumption rents, then $-\frac{(p_1c_1-k)p_1}{p_1c_1}+\frac{dp_1}{dt}<\frac{dp_1^*}{dt}$, since some of the tax wedge will show up in a reduced final-goods producer price. This reduces in absolute value the numerator of the left-hand side of (4.26), making it more likely that the

[15] One might have expected different conditions even in this special case, as the sales-apportioned tax introduces a consumption distortion not present under the destination-based tax. However, our experiment considers the introduction of a small tax, for which there is no first-order deadweight loss. Although the analysis would be more complicated, a larger sales-apportioned tax would presumably be less attractive due to the associated consumption distortion.

condition will be met (since the overall term is negative); with consumption rents, some of the burden of the sales-apportioned tax falls on producers, and some of this burden on producers is borne by foreign owners.

Note that this differs from the case of the destination-based tax because there is no substitution away from consumption of good 1 in that case. While the substitution effect results in a distortion in this case, the introduction of a small tax has only second-order deadweight loss but first-order incidence effects. Thus, for a small shift away from source-based taxation, sales apportionment may be preferable to a destination-based approach, as the more favorable incidence effects may outweigh the small distortions to domestic consumption. But this trade-off would presumably be less favorable for a larger tax shift because of the nonlinearity of deadweight loss, and also does not account for the additional distortions of sales-apportioned taxes, already discussed above, which are not in the model.

5. Conclusions

This paper models the effects of cash-flow taxes in a two-country model with trade of semi-finished goods and a representative multinational that produces and sells in each of the countries and allocates capital and managerial skill between them for production. There are three sources of rents in the base case which are assumed all accrue to the multinational: a fixed factor in each country of basic production; managerial skill, 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. We describe the production and consumption distortions these taxes generate.

We investigate whether there is an incentive for a national government to move away from an equilibrium in which both countries use only the standard source-based tax. We show that the government faces a trade-off. One 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 incorporated in our analysis) that are 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 and transfer-pricing manipulation. 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. In this case, substitution away from the source-based tax in the direction of the destination-based tax or a sales-apportioned tax increases domestic welfare.

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APPENDIX

This appendix gives derivations of various results presented in the text.

1. Derivation of expression (3.15)

From (3.13), profits are:

(A.1) $\pi = (p_1 h(x_1) + p_1^* h(f(k,m) + f(K-k, M-m) - x_1) - K)[1 - ta - t^*(1-a)],$

where $a = \frac{p_1 h(x_1)}{p_1 h(x_1) + p_1^* h(f(k,m) + f(K-k, M-m) - x_1)}.$

Differentiating with respect to K yields:

(A.2) $\left(p_1^* h'(x_1^*) f_1(k^*, m^*) - 1\right)[1 - ta - t^*(1-a)] - \pi(t - t^*)\frac{da}{dK} = 0.$

But $\frac{da}{dK} = -\frac{a}{p_1 c_1 + p_1^* c_1^*} p_1^* h'(x_1^*) f_1(k^*, m^*)$, so (A.2) simplifies to:

(A.3) $\left[1 + \frac{a\pi^G(t-t^*)}{[1-ta-t^*(1-a)](p_1 c_1 + p_1^* c_1^*)}\right] p_1^* h'(x_1^*) = \frac{1}{f_1(k^*, m^*)}$

Expression (3.15) follows from the fact that there is production efficiency. A similar expression for the home country follows from the first-order condition with respect to x_1.

2. Derivation of results stated around (4.12) that (1) $\frac{d(e-e^*)}{ds} < 0$; and (2) consumer prices are the same when the initial equilibrium is symmetric with marginal cost pricing:

Combining expressions (3.10) and (3.11),

(A.4) $\frac{1}{f_1^*}(f_1 - f_1^*)(1 - s^*) + (1 - q f_1)(s - s^*) = 0$

The derivative of this expression with respect to *s* is:

(A.5) $$\frac{1}{f_1^*}(1-s^*)\frac{df_1}{ds} - \frac{f_1}{f_1^{*2}}(1-s^*)\frac{df_1^*}{ds} + (1-qf_1) - q(s-s^*)\frac{df_1}{ds} = 0$$

With initial marginal cost pricing, $q = \frac{1}{f_1^*} = \frac{1}{f_1}$, so (A.5) reduces to

(A.6) $$(1-s)\frac{df_1}{ds} = (1-s^*)\frac{df_1^*}{ds}$$

Combining expressions (3.10) and (3.12),

(A.7) $$\frac{1}{f_1^*}(f_2 - f_2^*)(1-s^*) - qf_2(s-s^*) = 0$$

Differentiating with respect to *s* yields:

(A.8) $$\frac{1}{f_1^*}(1-s^*)\frac{df_2}{ds} - \frac{1}{f_1^*}(1-s^*)\frac{df_2^*}{ds} - \frac{(f_2-f_2^*)}{f_1^{*2}}(1-s^*)\frac{df_1^*}{ds} + -qf_2 - q(s-s^*)\frac{df_2}{ds} = 0$$

By initial marginal cost pricing, $q = \frac{1}{f_1^*}$; using this and using (A.7) to substitute for $(f_2 - f_2^*)$ yields:

(A.9) $$(1-s^*)\frac{df_2}{ds} - (1-s^*)\frac{df_2^*}{ds} - \frac{f_2}{f_1^*}(s-s^*)\frac{df_1^*}{ds} + -f_2 - (s-s^*)\frac{df_2}{ds} = 0$$

Starting from an equilibrium in which $s = s^*$, expressions (A.6) and (A.9) reduce to:

(A.10) $$\frac{df_1}{ds} = \frac{df_1^*}{ds}$$

and

(A.11) $$\frac{df_2}{ds} - \frac{df_2^*}{ds} = \frac{f_2}{1-s}$$

Combining (A.10) and (A.11) and noting that starting from a symmetric equilibrium the second derivatives of the production functions are the same across countries, we obtain:

(A.12) $$\frac{dm^*}{ds} - \frac{dm}{ds} = -\frac{f_{11}}{D}\frac{f_2}{(1-s)} > 0$$

(A.13) $$\frac{dk^*}{ds} - \frac{dk}{ds} = \frac{f_{12}}{D}\frac{f_2}{(1-s)} > 0$$

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.

Note that (3.9')-(3.11') imply that $p_1 h' = p_1^* h^{*'}$. Since marginal utility equals the price in each country, this implies that $u'\big(h(x_1)\big)h'(x_1) = u^{*'}(h(x_1^*))h'(x_1^*)$, where we have used the fact that the *functions* $h(.)$ and $h'(.)$ are the same in the two countries. Thus, if preferences are the same in the two countries, we have $u'\big(h(x_1)\big)h'(x_1) = u'(h(x_1^*))h'(x_1^*)$. This expression is satisfied if $x_1 = x_1^*$, and the solution is unique: since both h'' and u'' are negative, the derivative of either side with respect to its argument is negative, so the equality cannot hold for $x_1 \neq x_1^*$. Hence the increase in s decreases domestic production but does not change relative consumption. Therefore, domestic exports fall with s.

Note also that, because consumption of good 1 remains the same in the two countries, so must the price of good 1, again under the assumption of common preferences, equal initial tax rates, and marginal cost pricing.

3. Derivation of the last line of (4.19):

Since $D = q_r + q_\rho = p_1 c_1 + \bar{q}(e - e^*) - k - \bar{q} f_2 m$,

$$-\frac{dD}{ds} = -c_1\frac{dp_1}{ds} - p_1\frac{dc_1}{ds} - \bar{q}\frac{d(e-e^*)}{ds} - (e - e^*)\frac{d\bar{q}}{ds} + \frac{dk}{ds} + \bar{q} f_2\frac{dm}{ds} + m\frac{d(\bar{q} f_2)}{ds}$$

so $\left(c_1 \frac{dp_1}{ds} - \frac{dD}{ds}\right) = -p_1 \frac{dc_1}{ds} - \bar{q}\frac{d(e-e^*)}{ds} - (e - e^*)\frac{d\bar{q}}{ds} + \frac{dk}{ds} + \bar{q}f_2 \frac{dm}{ds} + m\frac{d(\bar{q}f_2)}{ds}$

$$= -p_1 h' \frac{dx_1}{ds} - \bar{q}\left(\frac{df}{ds} - \frac{dx_1}{ds}\right) - (e - e^*)\frac{d\bar{q}}{ds} + \bar{q}\left(\frac{1}{\bar{q}}\frac{dk}{ds} + f_2\frac{dm}{ds}\right) + m\frac{d(\bar{q}f_2)}{ds}$$

$$= -\bar{q}\frac{df}{ds} - (e - e^*)\frac{d\bar{q}}{ds} + \bar{q}\left(f_1\frac{dk}{ds} + f_2\frac{dm}{ds}\right) + m\frac{d(\bar{q}f_2)}{ds} = -(e - e^*)\frac{d\bar{q}}{ds} + m\frac{d(\bar{q}f_2)}{ds}$$

as appears in expression (4.19). A similar result follows for $\left(c_1^* \frac{dp_1^*}{ds} - \frac{dF}{ds}\right)$.

4. Derivation of (4.20):

Starting from an initial symmetric equilibrium and with marginal cost pricing, (4.19) becomes:

(A.14) $$-s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right) > \frac{\left[\bar{q}f_2 m + (1-s^*)m^*\frac{d(\bar{q}^* f_2^*)}{ds} - (1-s)m\frac{d(\bar{q}f_2)}{ds}\right]}{2}$$

But, using (A.10) – which implies that $\frac{d\bar{q}}{ds} = \frac{d\bar{q}^*}{ds}$ – and (A.11),

$$(1 - s^*)m^*\frac{d(\bar{q}^* f_2^*)}{ds} - (1 - s)m\frac{d(\bar{q}f_2)}{ds}$$

$$= (1 - s)f_2(m^* - m)\frac{d\bar{q}}{ds} + \bar{q}\left[m^*\left(-f_2 + (1 - \mathrm{s})\frac{df_2}{ds}\right) - m(1 - s)\frac{df_2}{ds}\right]$$

$$= (1 - s)f_2(m^* - m)\frac{d\bar{q}}{ds} - \bar{q}f_2 m^* + (1 - s)\bar{q}(m^* - m)\frac{df_2}{ds}$$

so (A.14) may be rewritten:

$$-s\left(\frac{f_2}{f_1}\frac{dm}{ds}\right) > \frac{(m-m^*)\left[\bar{q}f_2 - (1-s)\frac{d(\bar{q}f_2)}{ds}\right]}{2} = 0$$

since $m = m^*$ in the initial symmetric equilibrium.