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FORMULA APPORTIONMENT: IS IT BETTER THAN THE CURRENT SYSTEM AND ARE THERE BETTER ALTERNATIVES?

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This analysis of formula apportionment compared to the current U.S. system recognizes that income shifting has two main sources, excess returns attributable to intangibles and debt, and that a major goal of income division systems is preserving neutrality between arm's length and related party transactions. A model demonstrates that separate accounts (SA) and formula apportionment (FA) distort behavior along different margins. Simulations indicate that FA has no clear advantage over SA. Static estimates of U.S. tax revenues under FA suggest potentially large increases, but simulations show that revenue under FA and SA is similar once behavioral responses are taken into account.

Keywords: formula apportionment, transfer pricing, income shifting, international taxation

JEL Codes: H25, H73, H87

I. INTRODUCTION

The growing integration of the world economy, the difficulties in calculating arm's length prices for inter-company transactions and the increased opportunities for income shifting that result have motivated a greater interest in formula apportionment as the solution to the conundrum of how to tax the cross-border income of multinational corporations (MNCs). Under formula apportionment, intercompany transactions are ignored and the share of consolidated worldwide income allocated to a jurisdiction depends on the share of worldwide measurable factors such as capital, payrolls and sales that are located there. The European Union is considering whether to adopt a "Common Consolidated Base" within the EU and Avi-Yonah and Clausing

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(2007) among others have recently proposed that the United States implement formula apportionment.[1]

Any evaluation of formula apportionment has to start with an analysis of the sources of income shifting, which it is, after all, designed to eliminate. Evidence from U.S. MNCs suggests that profitability disparities between high and low tax countries have been increasing, suggesting that income shifting may be getting worse (Altshuler and Grubert, 2005). Grubert (2003) indicates that for U.S. MNCs the shifting of R&D derived intangible income and the location of debt account for virtually all of the profitability disparity between operations in high and low tax countries. In particular, the shifting of income from intangibles assets like patents and trademarks to low tax countries is a major source of profitability differences across high and low tax countries. In this paper, we argue that formula apportionment is not equipped to deal effectively with either source of income shifting.

A comparison of formula apportionment (FA) and separate accounts (SA) must also start with an evaluation of the economic basis for using the "arm's length" principle to set transfer prices for transactions between related parties. Why would the arm's length principle be optimal if there were no uncertainty about what transfer prices should be and they were costless to compute? Most studies either ignore or misstate the efficiency properties of arm's length prices in a world of costless information. To evaluate efficiency properties of a transfer price or income splitting system, it is necessary to clarify the decision margins that will be impacted. *Choosing a method is an issue of matching policy instruments with decision margins*. The role of the transfer pricing system must be considered as a component of a larger system in which specific policy instruments are assigned to the decision margins they can most directly address.

The purpose of a transfer price or income division system is *not* to offset the effect of differing country tax rates on investment.[2] A country chooses its corporate tax rate based on the level of personal tax rates, the size of government expenditures and the competition it faces from other jurisdictions, among many other factors. The transfer price system is only relevant in this context to the extent that pricing distortions interfere with the choice of a corporate tax rate.[3]

The transfer price or income division system is directly matched with two decision margins — the choice between arm's length and related party transactions, and the choice between exporting and production abroad. Tax neutrality between MNCs and single jurisdiction companies, which should be a goal of any system, requires that neither margin be distorted. If the MNC can shift intangible income to a low tax affiliate, then the MNC has an incentive to transact with its affiliate even if it is less efficient than an unrelated party in the same market. Similarly, charging a high tax affiliate more than the

[1] See Martens-Weiner (2006) for an extensive discussion of interest in business income tax reform in the EU and the issues that member countries would have to confront if they were to adopt a formulary apportionment system with a common consolidated tax base.

[2] McLure (2007) seems to consider only this distortion.

[3] The transfer price-income division system is too indirect and unpredictable to play much of a role in the choice of a corporate tax rate. If policy makers are concerned that the country is losing investment because of a high corporate tax rate, they can lower the rate or offer incentives to new investors.

arm's length price favors transacting with the affiliate over the arm's length competitor who is fully subject to the high tax rate.

Therefore any analysis of a transfer price or income splitting system must consider the possibility of transactions with unrelated parties as well as the choice between exporting and producing abroad. In the case of valuable intangibles, the important choice is between licensing to a related party or an unrelated party abroad. Under FA, transactions with unrelated parties involving routine goods also become important because the activities that remain in-house enter into the allocation formula.

Tax planning under either SA or FA can therefore cause two types of welfare losses, each of which must be included in a complete analysis. The most obvious is the revenue loss which will force the government to rely on more distorting taxes. In addition, opportunities for income shifting alter the effective tax rate on investments by *related* companies in high and low tax countries. This distorts the choice between transactions with related and unrelated companies, the choice of investment location, and also discriminates against stand-alone local companies. The effective tax rate distortion may also, as mentioned above, force the government to alter its mix of various types of income and consumption taxes.

This paper illustrates the type of model that is required to make a complete analysis of which system is preferable. We present a model highlighting the importance of intangible excess returns that allows for a rich range of responses. We model a typical firm that has both high-tech and low-tech lines of business each of which can be located in several jurisdictions. In contrast to the current SA system, under FA the firm can shift income to the low tax jurisdiction by locating the routine low-tech stage there. The company can also either outsource routine activities and components or "insource" them by producing in-house what they can purchase from unrelated parties. The model shows that companies have an incentive to make large behavioral adjustments under both systems, but along different margins.

A simulation model is helpful in evaluating the two systems. We develop and present results from a simulation that allows us to make a comparison of SA and FA. The simulations indicate that FA has no clear advantage over SA even when the model assumes that an unrealistically large amount of resources are devoted to tax planning under SA.

We evaluate the static revenue consequences of multilateral adoption of FA on U.S.-based MNCs using the Treasury tax files for 1996 and 2004 in combination with data provided by the Bureau of Economic Analysis (BEA) of the U.S. Commerce Department. For U.S. companies in nonpetroleum manufacturing we estimate a static (no behavioral response) revenue gain to the U.S. Treasury of $23.7 billion under FA and a loss of revenues by foreign governments of $14.7 billion for 2004.[4] The revenue gain can enhance efficiency to the extent that it permits a general lowering of tax rates. Our simulations indicate, however, that FA is unlikely to raise much revenue after behavioral changes are taken into account.

Our basic model considers formulas that split income based on the location of tangible capital. Many of the states in the United States use a formula based exclusively on sales. Avi-Yonah and Clausing (2007), among others, have proposed using sales as a basis for taxing cross-border income. We present two simple models that consider sales based

[4] These should in no way be interpreted as official U.S. Treasury estimates.

formulas. As is the case with our analysis of SA versus FA using formulas based on the location of tangible capital, we find that both systems distort incentives but along different margins. Sales based formulas do not seem to have any clear advantages over capital or payrolls based formulas.

The paper illustrates one of the general problems with formula apportionment, the potential asymmetry between the determinants of taxable income and the items that enter the formula. Intangible assets that increase taxable income but are impossible to measure are one example. If payrolls are in the formula, this becomes a source of another asymmetry because wage costs are deductible from taxable income. Companies can exploit the asymmetry by adding labor intensive activities in the low tax country. They would go beyond the normal equality of the marginal productivity of labor with wage costs because of the benefits of the lower tax rate.

Our models, while illustrative, do not explicitly consider some of the potential strengths and weaknesses of FA. Under FA, income allocation is based on real variables like tangible capital, payrolls, and sales. Income therefore cannot be shifted to tax havens in which there is no real business activity. But that leaves the question of what to do with financial assets and earnings, particularly in nonfinancial companies with a significant financial business. We address these issues in the context of our simple model and conclude that financial income plays the same distorting role as supernormal intangible income under FA. Financial income offers fewer opportunities for income shifting under the current SA system. We also contrast the treatment of ongoing R&D and cost sharing agreements under FA and SA. Both systems lead to behavioral distortions that should be considered in any complete analysis. Finally, we consider whether straightforward changes could be made in SA that would result in substantial improvements without resorting to full-fledged FA.

The remainder of this paper is organized as follows. In the second section, we start by examining incentives under FA and SA using a simple theoretical model with an allocation formula based on the location of tangible capital. We then discuss the results of a simulation that allows us to compare different aspects of SA and FA as well as alternative formulas in the third section. In the fourth section, we compare the static (no behavioral response) revenue gain from FA with the effect of repealing deferral, which is another reform option that addresses the problem of income shifting. The fifth section presents simple models that allow us to compare behavioral distortions under SA and FA using sales based formulas. We posit how our simple model could be extended to incorporate investment in financial assets (and the location of the assets) as well as cost sharing agreements and licensing for R&D in the sixth section. The seventh section considers whether positive aspects of FA could be achieved more simply in the current system. We draw conclusions from our work in the final section.

II. A MODEL FOR EVALUATING FA AND SA

A. Background on the Current U.S. Tax System

Before presenting a simple model to evaluate the important decision margins impacted under SA and FA, we briefly describe the current U.S. system for taxing cross-border

income and the incentives it creates for income shifting.[5] The United States imposes a tax on all foreign income when it is remitted, including not only dividends but also royalties, interest and other foreign payments.[6] Certain types of foreign income do not benefit from deferral and are instead taxed upon accrual under what are generally referred to as Controlled Foreign Corporation (CFC) rules. A CFC is a corporation organized outside the United States (a foreign corporation) that is more than 50 percent owned by U.S. shareholders. In general, the CFC rules deny deferred taxation on foreign subsidiary income that is considered abusive or "tainted." Tainted income includes passive portfolio income and the payment of interest, dividends and royalties from one CFC to a CFC in another jurisdiction.

Taxpayers receive a foreign tax credit against tentative U.S. tax for foreign taxes paid on foreign source income, including a credit for the underlying foreign corporate tax linked to a dividend. However, this credit is limited to what the U.S. tax would have been had the income been earned in the United States. Foreign income is separated into income baskets for the purpose of the foreign tax credit to restrict cross-crediting, i.e., credits flowing over from highly taxed income to shield income that has been lightly taxed. Under current law there are two income baskets, one for active income and the other for passive income. Within any basket, excess credits generated by one type of income (e.g., dividends) can flow over to other income in the basket (e.g., royalties) and shield that income from any residual U.S. tax. The ability to cross-credit royalties with dividends creates a tax incentive to exploit intellectual property like a patent for a new computer chip abroad rather than in the United States since the returns will escape U.S. taxation.

Tax provisions affecting royalties and the income from intangible assets in general are of particular importance because they have become a significant source of foreign direct investment income. The exploitation of parent "know-how" is a very important motivation for foreign investment.[7] The problems of estimating the "correct" arms' length royalties and the prices of intangible intensive goods and services in the current system create opportunities for shifting income to low tax locations. Placing debt in high tax locations and transferring very valuable intangible assets to low tax subsidiaries without adequate compensation in the form of royalties are probably the most important methods. As mentioned in the introduction, work with the Treasury tax files suggests that the location of intangible income and the allocation of debt among high and low tax countries seem to account for all of the observed differences in profitability across

[5] This section borrows heavily from Grubert and Altshuler (2008).

[6] Taxpayers can also identify certain income as "foreign source" even though it may have no connection with any U.S. business activity abroad. Income from exports is an example. Under the current "sales source" rules, 50 percent of export sales income can be classified as foreign source.

[7] Data published by the Department of Commerce indicate that royalties and license fees received by U.S. companies in 2004 amounted to $52.6 billion (U.S. Department of Commerce, 2005). Total direct investment income not including royalty income but including deferred income amounted to $233.6 billion in 2004. Treasury tabulations for 2000 indicate that royalties received by U.S. multinational companies (MNCs) amounted to $45.1 billion or more than 35 percent of total net repatriated nonfinancial foreign income, which is dominated by manufacturing. It is also of interest that these royalty payments only yielded additional taxes of $5.8 billion. Almost two-thirds were shielded by excess credits arising from dividends.

high and low statutory tax countries (Grubert, 2003). Moreover, recent work suggests that royalties represent less than half of the contribution that parent R&D makes to subsidiary income (Mutti and Grubert, 2006).

B. Relationship to Previous Literature

It would appear that in contrast to the current U.S. system, FA eliminates the incentives for tax planning because intercompany payments do not enter into the calculation. That this is incorrect has been clear at least since Gordon and Wilson (1986). They concentrate on the effect of FA on the gross-up in the pre-tax rate of return in the high tax jurisdiction required for the company to break even. Under FA, the company has an incentive to spread this excess return to a low tax state by merging with companies in the low tax state.

The model we present below differs from Gordon and Wilson and more recent work in the literature by allowing for two kinds of capital (high-tech capital that produces highly profitable products and routine capital) along with the possibility of outsourcing production (Eggert and Schjelderup, 2005; Nielsen, Raimondos-Møller and Schjelderup, 2003, 2010). In addition, we assume a pre-existing intangible that earns rent which seems most relevant for a study of income shifting. For many MNCs these intangible returns can far exceed the "normal" returns to capital. This model allows us to present a more complete picture of how FA and SA encourage MNCs to make adjustments along different margins. Our work also departs from the previous literature by including simulation analysis.

Simulations are useful in evaluating SA and FA in a world with large tax differences. As we consider lower and lower tax rates abroad, the relative significance of various distortions may change. For example, the benefits of devoting additional resources to income shifting under SA declines rapidly as the share of economic income shifted gets very high. In contrast, the marginal benefits of shifting capital from the high tax country to the low tax country under FA declines very slowly because the denominator in the allocation ratio, total capital in the case of capital based formulas or sales in the case of sales based formulas, remains unchanged.

C. A Simple Model

The arm's length SA system encourages MNCs to locate highly profitable products in low tax countries and to engage in planning that permits more shifting of income to the low tax location by underpaying royalties to the parent. These opportunities distort the choice of location for investment and also the decision of whether to license profitable technologies to unrelated parties.

Under FA, companies also have an incentive to locate more high profitable operations in low tax locations to attract more of the excess return, but further "financial" planning in the form of transfer price manipulation and the location of debt provides no additional benefit. On the other hand, FA encourages the companies to reduce their

activities in high tax locations even if they are not shifted abroad. For example, MNCs can "outsource" the production of low-tech components and routine services to reduce apportionment of income to the high tax location. This provides no benefit in arm's length income SA allocations for highly profitable products. Similarly, firms have an incentive to "insource" routine activities to low tax locations. Also, and probably more important, it is no longer necessary to locate the high-tech stage of production in a low tax jurisdiction to locate excess returns there under FA because routine assembly and packaging can do as well in attracting more of the excess return.

Thus, one fundamental difference between FA and SA is aggregation. Under SA, companies can "cherry pick" among their products and move only the most profitable to low tax locations. Under FA, the excess returns from very profitable products are spread over a much larger capital base. A dollar of investment in a low tax location will attract a smaller percentage of total excess returns. This would seem to favor FA in that the efficiency loss depends on the square of the tax discrepancy. On the other hand, this larger base of capital is now eligible for being shifted abroad to attract the excess return. As we will see, under FA the company has a wider range of adjustments it can make, and furthermore these additional adjustments involve routine or low-tech products and services which can be more easily shifted in or out of the company or from one location to another.

These considerations can be illustrated in a simple model. The purpose is to clarify the differing responses by companies to tax differentials under FA and SA. We assume that, as is typical for U.S. MNCs, the company has a valuable intangible that permits it to earn substantial supernormal returns. The company produces a product for the world-wide market and faces a demand curve, $P(Q)$, reflecting its market power. We assume that the monopolist cannot price discriminate. There are two stages of production, a high-tech stage and a routine component or services stage. For simplicity we assume that tangible capital is the only factor of production and that the formula is based purely on capital shares. We consider the implications of sales based apportionment in Section V.

The final product, Q, is therefore a function of two separable functions, one for the advanced stage, $H(\cdot)$ and one for the routine stage, $R(\cdot)$. Thus $Q = Q(H(\cdot), R(\cdot))$. We assume, realistically, that there is low substitutability between these two upper level functions. The output of the high-tech stage is a function of high-tech capital at home, K_1^H and similar capital in the foreign country, K_2^H so that $H = H(K_1^H, K_2^H)$.[8] Production in the routine stage is a function of four types of capital: capital at home in the company's own operation KR_1^I, capital used by domestic suppliers of routine goods and services KR_1^O, capital in the company's own operations abroad KR_2^I, and finally capital used by suppliers abroad KR_2^O.[9] Production in the routine stage at home is a function of routine capital at home $R_1 = R(KR_1^I, KR_1^O)$, production in the routine stage abroad is a function of routine capital abroad $R_2 = R(KR_2^I, KR_2^O)$ and total routine production is a nested

[8] We assume appropriate convexity to avoid boundary or specialization problems.

[9] Outsourced capital does not refer to leased capital. The U.S. states multiply the lease payment by a factor for the purpose of the formula.

function $R = R(R_1,R_2)$. It seems reasonable to assume that the elasticity of substitution between the various types of routine capital is greater than between the two types of advanced capital. That is, it is easier to move routine operations abroad and insource or outsource routine operations than to move advanced operations abroad.

The company maximizes after-tax rents under both SA and FA. The difference is in how tax liability in each country is determined. Under SA, we assume that the issue is how to divide the rent or excess return. We assume that under SA some of the supernormal returns can be shifted to the low tax foreign location but only if high-tech production takes place there. In other words, the MNC must actually produce the super drug or microprocessor abroad to shift some of the intangible income abroad. The normal return on the tangible capital is given to the country in which it is located. We let Country 1 be the high tax country and denote its corporate tax rate t_1. Country 2, the low tax country, has corporate tax rate t_2 (where $t_1 > t_2$). Our interest is in considering cases in which there are large statutory rate differentials.

The share, S, of the rent allocated to the low tax country depends on the amount of high-tech capital in each location and a third factor, K^M, the amount of capital devoted to tax planning. An increase in high-tech capital in the low tax location K_2^H will increase the share of rent located there [$(\partial S/\partial K_2^H \geq 0)$ and $(\partial S/\partial K_1^H < 0)$]. Initially an increase in K^M enhances the benefits of having more capital in the low tax country. But S, the share of rent shifted, cannot exceed one, so that if K^M is very productive an increase in K^M may make it unnecessary to shift much capital to the low tax location. That is K^M and K_2^H become substitutes not complements.[10] Note that the shifting function itself depends on government policy. For example, the United States implicitly lowered the cost of income shifting in 1997 with the enactment of the "check the box" rules.

Under FA, tax planning to manipulate transfer prices is of no use. As we will see, what does matter is the amount of aggregate *in-house* capital in each location relative to total in-house capital. Furthermore, the division of profits applies to all capital returns including the normal return to high-tech capital.

1. *After-tax Economic Profits*

Total pre-tax rents or economic profits, E_{SA}, under separate accounts are:

$$E_{SA} = P(Q)Q - C_{SA}(\cdot)$$

where

$$C_{SA}(\cdot) = (K_1^H + KR_1^I + KR_1^O + K^M)\left(\frac{r}{1-t_1}\right) + (K_2^H + KR_2^I + KR_2^O)\left(\frac{r}{1-t_2}\right).$$

The required return on capital is r and the costs under SA for the MNC are $C_{SA}(\cdot)$. They are the pre-tax returns required to pay the suppliers of capital. We assume that only

[10] In the simulations, we use a bounded exponential to embody these features.

high-tech production in the low tax location can justify locating some of the rent in that location. Therefore, the tax liabilities on these rents, T_{SA}, are:

$$T_{SA} = E_{SA}S(K_1^H, K_2^H, K^M)t_2 + E_{SA}(1 - S(K_1^H, K_2^H, K^M))t_1.$$

where $S = S(K_1^H, K_2^H, K^M)$ denotes the portion of pre-tax economic profits shifted abroad ($0 \leq S \leq 1$).

Under FA, the S function does not appear in the profit function nor does the cost of K^M. The calculation of tax liabilities starts with total pre-tax revenues, $P(Q)Q$ minus costs on outsourced capital. This return is divided between the two jurisdictions based on the ratios of total in-house capital. The share allocated to country 1, α, is

$$\alpha = \frac{K_1^H + KR_1^I}{K_1^H + KR_1^I + K_2^H + KR_2^I}$$

After-tax economic profits under FA are

$$P(Q)Q - C_{in} - C_{out} - (P(Q)Q - C_{out})(\alpha t_1 + (1 - \alpha)t_2)$$

where $C_{in} = r(K_1^H + K_2^H + KR_1^I + KR_2^I)$ are costs for in-house capital and $C_{out} = r(KR_1^O/(1 - t_1) + KR_2^O/(1 - t_2))$ denotes costs for outsourced capital.

Before proceeding to the maximum after-tax profit conditions, we note the decision margins that come into play in shifting income under the two systems. Under SA, the company can, for given worldwide production, decide where to locate high-tech capital. The location of capital needed for routine production does not justify a larger share of the rents. The company also decides on the level of resources to devote to tax planning with transfer prices.

The company also chooses where to locate high-tech capital under FA. But manipulating transfer prices plays no role. The company does have additional margins to shift more pre-tax income to the low tax location, however. Locating more of the routine operation in the low tax location now does attract more of the profits. And outsourcing more of the home-based routine operations gets them off the high tax books. By creating more margins to manipulate, FA provides increased opportunities for shifting income. In addition, one might reasonably expect that it is easier to reallocate routine activities than more advanced operations.

2. Optimizing Conditions

We now proceed to characterize the optimizing conditions for capital investment. For simplicity, we use a constant elasticity demand function in our derivations: $P = aQ^{1/\varepsilon}$ where ε denotes the price elasticity of demand. We use this same parameterization in our simulations.

The maximization problem for the MNC under SA is:

$$\max E_{SA}(1 - St_2 - (1 - S)t_1) \text{ over } \{K_1^H, K_2^H, KR_1^I, KR_2^I, KR_1^O, KR_2^O, K^M\}.$$

The first-order conditions are as follows:

$$(1) \quad \frac{\partial Q}{\partial K_i^H} = \left(\frac{r}{1-t_i}\right)\frac{1}{aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)} - \left(\frac{E_{SA}\frac{\partial S}{\partial K_i^H}(t_1 - t_2)}{1-t_{SA}}\right)\frac{1}{aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)} \quad \text{for i} = 1,2$$

$$(2) \quad \frac{\partial Q}{\partial KR_i^I} = \frac{\partial Q}{\partial KR_i^O} = \left(\frac{r}{1-t_i}\right)\left(\frac{1}{aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)}\right) \quad \text{for i} = 1,2$$

$$(3) \quad \frac{\partial \pi_{SA}}{\partial K^M} = 0 \Rightarrow \frac{\partial S}{\partial K^M} = \frac{\frac{r}{1-t_1}(1-t_{SA})}{E_{SA}(t_1 - t_2)}$$

where $t_{SA} = (1 - S)t_1 + St_2$.

We can draw some straightforward observations from these first-order conditions. These observations are similar to previous findings in the literature. Regarding optimal investment in high-tech capital under SA, recall that $\partial S/\partial K_1^H < 0$ and $\partial S/\partial K_2^H \geq 0$. Thus the marginal cost of high-tech investment is lower in the low tax country relative to the high tax country. This is because the high tax investment enables the shifting of income from high to low tax locations. The extent to which the marginal cost of high-tech investment in the low tax country is lowered (and the marginal cost of investment in the high tax country is increased) depends on the level of excess returns, the shifting function, and, importantly, the difference in tax rates across locations. Note that the extent that investment in high-tech capital in the low tax country decreases the cost of capital there depends on the investment the company has made in K^M. Equation (3) shows that the optimal amount of capital invested in tax planning, K^M, depends on the level of excess returns and the tax differential. Finally note that the choice between insourcing and outsourcing routine capital is not distorted under SA. This result will not hold, as we will see, in the case of FA.

The maximization problem for the MNC under FA is:

$$\max E_{FA} - (P(Q)Q - C_{out})(\alpha t_1 + (1 - \alpha)t_2) \text{ over } \{K_1^H, K_2^H, KR_1^I, KR_2^I, KR_1^O, KR_2^O\}$$

where pre-tax earnings are $E_{FA} = P(Q)Q - C_{in} - C_{out}$. The first-order conditions for investment are:

$$(4) \quad \frac{\partial Q}{\partial K_1^H} = \frac{\partial Q}{\partial KR_1^I} = \frac{r}{(1-t_{FA})aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)} + \left(\frac{(1-\alpha)(t_1-t_2)Q}{(1-t_{FA})\hat{K}\left(1+\frac{1}{\varepsilon}\right)}\right)$$

$$(5) \quad \frac{\partial Q}{\partial K_2^H} = \frac{\partial Q}{\partial KR_2^I} = \frac{r}{(1-t_{FA})aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)} - \left(\frac{\alpha(t_1-t_2)Q}{(1-t_{FA})\hat{K}\left(1+\frac{1}{\varepsilon}\right)}\right)$$

$$(6) \quad \frac{\partial Q}{\partial KR_i^O} = \left(\frac{r}{1-t_i}\right)\frac{1}{aQ^{1/\varepsilon}\left(1+\frac{1}{\varepsilon}\right)}$$

where $t_{FA} = \alpha t_1 + (1-\alpha)t_2$ and $\hat{K} = K_1^H + K_2^H + KR_1^I + KR_2^I$.

Again, some straightforward observations can be drawn from the optimal investment conditions. First note that the marginal cost of high-tech capital and in-house routine capital in each location is the same under FA. Furthermore, the choice between insourcing and outsourcing is distorted. High-tech capital and routine in-house capital in the low tax location have lower marginal costs than the same capital placed in the high tax location (compare 4 and 5). This, of course, is due to the symmetric treatment of high-tech and in-house capital in the formula.

Before discussing the simulations, we can make some more qualitative statements. First, interactions between the various types of capital can be important. That is one of the motivations for the simulations. For example, outsourcing routine activities in the high tax location is particularly valuable because it shrinks the denominator in the allocation formula and enhances the benefits of shifting capital from the high tax to the low tax location. Also, an observation from simply inspecting the allocation formula is that the marginal benefits of shifting capital from the high tax location to the low tax location declines very slowly. The denominator only changes to the extent that the inefficiency caused by the shift requires total capital to increase for a given level of output. In contrast, under SA the marginal benefits of shifting high-tech capital to the low tax location would decline very rapidly if profit shifting is very easy.

Note that at this stage the model does not represent the ability to license the high-tech product to unrelated parties. One way to introduce licensing that we plan to explore in the future is by separating the production of routine and high-tech goods as different busi-

ness lines. Only the high-tech good would have some monopoly power and earn excess returns. Part of high-tech production could be produced by an arm's length licensee. (The high-tech production would be split between related and unrelated parties because they each have rising marginal costs — we would assume no integration benefits). The arm's length licensee would be willing to pay all of its excess profits as a royalty because it has no valuable intangible asset of its own to contribute. The parent would therefore maximize total (combined) after-tax profits to get the division between arm's length and related party production. This extension to the model would allow us to explore the choice between licensing a related or unrelated party abroad under FA and SA.

III. SIMULATIONS

A. Parameterization of the Model

We simulate the implications of the model described above and present results in a series of tables discussed below. Table 1 presents the functional forms and parameters used in the simulations.[11] As indicated above, worldwide production is a function of high-tech and routine capital at home and abroad. Worldwide high-tech capital, which is a CES function of high-tech capital in each location, is not very substitutable with routine capital. Routine capital is a function of nested CES functions, made up of composite routine capital in each location, which in turn is a function of in-house and outsourced capital in the location. In our base case, we assume a hierarchy of substitutability, with an elasticity of substitution of –1 between the high-tech capitals, –2 between the routine composites in each location, and –3 between in-house and outsourced capital in each location. The elasticity of demand for the final product, indicating the company's market power attributable to its valuable intangible, is –2 in the base case, making for an excess return equal to 100 percent of the normal return.

The shifting function, giving the share of the company's monopoly rent that is shifted to the host country under SA, is a bounded exponential depending on K^M, the resources devoted to financial manipulation, and the share of high-tech capital located abroad. The bounded exponential is chosen, in part, because the share of rents shifted abroad cannot exceed one. The power in the exponential is the product of K^M and the capital share because they, at least initially, are complementary; the ability to shift income to the low tax location increases as more high-tech capital is located there. The parameters are calibrated so that about 4 percent of total capital is devoted to K^M when there is a large difference in tax rates and most of the rent is shifted.[12] We assume that if K^M is

[11] The elasticities we use in the simulations are not based on actual econometric estimates, which are not available for the specific activities in the model. We do perform sensitivity tests, however. Relative responsiveness on different margins, not the absolute levels, is most important for the results.

[12] We want to be fair to FA by assuming that the manipulation of transfer prices and other tax planning under SA requires real resources. Because we do not have labor explicitly in the model, we use K^M to stand for the lawyers and accountants devoted to the process. While four percent of total capital as a cost for tax planning is probably high, we use it to bias the results in favor of FA.

Table 1

Parameterization of Model

	Base Case	Reduced Substitutability Between Routine Capital	Increased Economic Rents
	Elasticity of Substitution $1/(1-\rho)$		
Output $Q = \left(\frac{1}{2}H^{\rho} + \frac{1}{2}R^{\rho}\right)^{\frac{1}{\rho}}$	–0.2	–0.2	–0.2
High-tech capital $H = \left(K_1^H\right)^{\frac{1}{2}}\left(K_2^H\right)^{\frac{1}{2}}$	–1.0	–1.0	–1.0
Routine capital $R = \left(\frac{1}{2}\left(KR_1\right)^{\rho} + \frac{1}{2}\left(KR_2\right)^{\rho}\right)^{\frac{1}{\rho}}$	–2.0	–1.0	–2.0
Routine capital at home $KR_1 = \left(\frac{1}{2}\left(KR_1^O\right)^{\rho} + \frac{1}{2}\left(KR_1^I\right)^{\rho}\right)^{\frac{1}{\rho}}$	–3.0	–2.0	–3.0
Routine capital abroad $KR_2 = \left(\frac{1}{2}\left(KR_2^O\right)^{\rho} + \frac{1}{2}\left(KR_2^I\right)^{\rho}\right)^{\frac{1}{\rho}}$	–3.0	–2.0	–3.0
	Price elasticity of demand, ε		
Demand $P = (1/800)Q^{1/\varepsilon}$	–2.0	–2.0	–1.5

Shifting function

$S = 1 - e^{-.04(Share)K^M}$ where $Share = \frac{K_2^H}{K_1^H + K_2^H}$

zero and there is no shifting, all of the rent is paid to the parent in the form of royalties because that is where the intangible was created.

In each of the scenarios with the differing elasticities in the tables, we present three columns. Column 1 gives the results for a no-shifting equilibrium under SA, column 2 presents the shifting equilibrium and column 3 has the FA equilibrium. The response by the companies under SA and FA will be compared with the column 1 non-shifting equilibrium at the same tax rates because, as noted above, we want to separate the "normal" effect of tax differences on location from the added consequences of incentives to shift income under SA and FA. In each case, we start with tax rates equal to 35 percent in both countries and then proceed to present the simulations for tax rates of 25 percent and 10 percent in the low tax foreign location. To give a complete picture, the tables present the amount and location of the various types of capital, the marginal effective tax rates on this capital, each country's tax revenue, economic profits, the share of economic profits shifted, and final selling prices.

B. Simulation results

Table 2 presents simulation results for the base case. These results show that FA seems to have more dramatic effects than SA on the allocation of capital, tax revenue and marginal effective tax rates. This is true even for high-tech capital which is the basic source of shifting under SA. Comparing SA and FA when the host country has a tax rate of 10 percent, for example, high-tech capital at home is about 5 percent lower under FA than SA and is about 5 percent higher in the host country. The distortion in routine capital used in-house under FA is particularly striking. (It hardly changes from the no-shifting case under SA). In-house capital declines by 28 percent at home and increases by 38 percent in the low tax host country. As expected, the use of outsourced capital moves in the opposite direction, although more modestly, so the change in the ratio of in-house to outsourced capital in each location under FA is very large.

The marginal effective tax rates on the various types of capital mirror the large changes in the location of capital under FA. In all cases, even high-tech capital, the marginal effective tax rates in the new equilibrium deviate more from the country statutory rates under FA. For example, when the host country has a 10 percent tax rate, the marginal effective tax rate on high-tech capital at home is 42 percent under SA versus 46 percent under FA. In the low tax location, it is zero under SA and a negative 4 percent under FA.

Somewhat offsetting the large change in the location of capital under FA is the use of shifting resources K^M under SA. When the foreign tax rate is 10 percent, this amounts to 4 percent of total capital. Tax revenues and economic profits (rents) under SA and FA are consistent with the responses of capital and the location of production. Economic profits and tax revenues are just slightly greater under FA and SA even when 4 percent of capital is devoted to tax planning under SA and 91 percent of economic profits are shifted to the low tax location. But the outcomes are very close, particularly when contrasted with the no-shifting equilibrium.

Table 3 reduces the substitutability between the various types of routine capital to see if there are dramatic changes in the results. The elasticity of substitution between the routine composites in the two locations is now –1 instead of –2, and the elasticity of substitution between in-house and outsourced capital in a location is –2 instead of –3. The changes in routine capital under FA are somewhat smaller, as one might expect. But the general pattern of the results is similar to the previous table. In the case of the 10 percent foreign tax rate, there are still very large changes in the location of routine capital under FA, such as the 31 percent increase in the use of in-house routine capital abroad and a 24 percent reduction at home. Furthermore, while there is less shifting of routine capital, more of the response under FA is diverted to high-tech capital. This is particularly notable in the marginal effective tax rate on high-tech capital abroad, which is now –8 percent.

Table 4 returns to the elasticities of substitution in the base case but changes the product demand elasticity to 1.5 from 2.0, increasing the profit margin on costs to 200 percent from 100 percent. The increased economic rents increase the incentive to shift income under both systems, but the impact, if anything, seems larger under FA. For example, routine in-house capital increases by 55 percent abroad when the host country has a 10 percent tax rate, compared to 38 percent in the base case. (There is of course little change under SA because the use of routine capital is not distorted.) The percentage shift of high-tech capital under FA compared to SA is also greater than in the base case. (The absolute difference in marginal effective tax rates is slightly larger under FA.) Thus it appears that increasing profit margins cause greater distortions to both routine and high-tech capital under FA compared to SA. On the other hand, the greater profit margins increase the investment in K^M under SA to 7 percent of total costs so the overall picture does not seem much changed.

We do not explicitly make welfare estimates for the home country in the tables but we provide most of the ingredients for doing so, i.e., the change in rents, government revenues, prices and output. We also give the marginal effective tax rate for each type of capital in each country as an indication of the distortions caused by each system. What is missing is the marginal value of government revenues which must, of course, be above a dollar. Otherwise, an increased ability of companies to shift income would be welfare improving. As noted earlier, the role of the transfer pricing system, whether SA or FA, is not to offset the "normal" (not price distorted) effect of the differences in corporate tax rates among countries. (That is why, in the simulation tables, we first present the normal effect of the corporate tax with no income shifting.) Any deviation from this pattern under SA or FA because of income shifting responses should result in a welfare loss.

We could in principle estimate the marginal value of government funds from a full model itself. If a rational government chooses a certain corporate tax rate, it must be that at that point the marginal benefits of the dollar are equal to the extra tax paid by the private sector plus the additional welfare losses cause by the tax. But, in any case, the changes in home country revenues and company rents are very close in magnitude under FA and SA, particularly when compared to revenues and rents in the no shifting

Table 2

Optimal Capital Stocks and Marginal Effective Tax Rates Under Separate Accounts and Formulary Apportionment (Base Case Simulations)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
High-tech capital									
Home	259.85	259.85	259.85	279.94	252.62	253.21	310.40	275.55	263.12
Host	259.85	259.85	259.85	323.01	354.98	353.44	429.78	478.80	503.21
Shifting capital	0.00	0.00		0.00	66.17		0.00	96.17	
Routine outsourced capital									
Home	226.21	226.21	226.21	225.83	225.11	235.51	224.26	223.30	238.36
Host	226.21	226.21	226.21	300.67	299.71	285.32	429.94	428.11	390.10
Routine insourced capital									
Home	226.21	226.21	226.21	225.83	225.11	172.29	224.26	223.30	138.16
Host	226.21	226.21	226.21	300.67	299.71	369.51	429.94	428.11	595.82
Marginal effective tax rates									
High-tech capital									
Home	0.35	0.35	0.35	0.35	0.41	0.41	0.35	0.42	0.46
Host	0.35	0.35	0.35	0.25	0.18	0.18	0.10	0.00	–0.04
Routine outsourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Host	0.35	0.35	0.35	0.25	0.25	0.25	0.10	0.10	0.10
Routine insourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.41	0.35	0.35	0.46
Host	0.35	0.35	0.35	0.25	0.25	0.18	0.10	0.10	–0.04

Table 2 (Continued)

Shifting, Tax Revenues and Rents under Separate Accounts and Formulary Apportionment
(Base Case Simulations)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
Profit shifting under Separate Accounts									
Share of high-tech capital in host	0.50	0.50	0.50	0.54	0.58	0.58	0.58	0.63	0.66
Percentage of rents shifted		0.00			0.79			0.91	
Cost of shifting (K^M/total capital)		0.00			0.04			0.04	
Profit split under Formula Apportionment									
Percent of profits allocated abroad			0.50			0.37			0.27
Tax revenue									
Home	115.06	115.06	76.71	121.92	58.20	64.09	131.88	51.51	54.04
Host	38.35	38.35	76.71	30.81	76.12	71.90	14.33	37.17	36.58
Rents	142.46	142.46	142.46	153.27	164.10	167.80	169.03	214.85	216.69
Price	1.83	1.83	1.83	1.70	1.70	1.70	1.54	1.54	1.54
Quantity	240.16	240.16	240.16	278.01	277.02	276.97	338.13	336.54	338.25

Note: The parameters used in simulations are shown in Table 1.

Table 3

Optimal Capital Stocks and Marginal Effective Tax Rates Under Separate Accounts and Formulary Apportionment (Reduced Substitutability Between Various Types of Routine Capital)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
High-tech capital									
Home	259.85	259.85	259.85	279.12	251.84	252.58	305.77	271.11	256.32
Host	259.85	259.85	259.85	322.07	353.99	354.73	423.37	472.14	508.75
Shifting capital	0.00	0.00		0.00	66.10		0.00	95.79	
Routine outsourced capital									
Home	226.21	226.21	226.21	242.99	242.22	254.83	266.18	265.04	290.41
Host	226.21	226.21	226.21	280.38	279.48	266.55	368.56	366.98	335.87
Routine insourced capital									
Home	226.21	226.21	226.21	242.99	242.22	208.48	266.18	265.04	202.32
Host	226.21	226.21	226.21	280.38	279.48	323.06	368.56	366.98	480.82
Marginal effective tax rates									
High-tech capital									
Home	0.35	0.35	0.35	0.35	0.41	0.41	0.35	0.42	0.46
Host	0.35	0.35	0.35	0.25	0.18	0.17	0.10	0.00	–0.08
Routine outsourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Host	0.35	0.35	0.35	0.25	0.25	0.25	0.10	0.10	0.10
Routine insourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.41	0.35	0.35	0.46
Host	0.35	0.35	0.35	0.25	0.25	0.17	0.10	0.10	–0.08

Table 3 (Continued)

Shifting, Tax Revenues and Rents under Separate Accounts and Formulary Apportionment

(Reduced Substitutability Between Various Types of Routine Capital)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
Profit shifting under Separate Accounts									
Share of high-tech capital in host	0.50	0.50	0.50	0.54	0.58	0.58	0.58	0.64	0.66
Percentage of rents shifted		0.00			0.79			0.91	
Cost of shifting (K^M/total capital)		0.00			0.04			0.05	
Profit split under Formula Apportionment									
Percent of profits allocated abroad			0.50			0.40			0.32
Tax revenue									
Home	115.06	115.06	76.71	123.59	59.99	69.80	135.39	55.74	63.84
Host	38.35	38.35	76.71	29.43	74.65	67.77	12.89	35.53	33.45
Rents	142.46	142.46	142.46	153.02	163.83	166.92	167.63	212.96	212.13
Price	1.83	1.83	1.83	1.70	1.70	1.70	1.55	1.55	1.55
Quantity	240.16	240.16	240.16	277.11	276.12	276.73	332.53	330.94	333.94

Note: In these simulations the substitutability between the various types of routine capital is reduced. The elasticity between routine capital in the two locations is –1 instead of –2 and the elasticity of substitution between insourced and outsourced capital in the two locations is –2 instead of –3. All other parameters are the same and are shown in Table 1.

Table 4

Optimal Capital Stocks and Marginal Effective Tax Rates Under Separate Accounts and Formulary Apportionment (Increased Economic Profits)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
High-tech capital									
Home	191.09	191.09	191.09	198.47	168.48	161.24	209.55	174.82	147.96
Host	191.09	191.09	191.09	229.00	265.40	267.08	290.14	340.96	366.62
Shifting capital	0.00	0.00		0.00	79.23		0.00	105.38	
Routine outsourced capital									
Home	166.35	166.35	166.35	160.11	159.19	173.46	151.39	150.34	167.96
Host	166.35	166.35	166.35	213.16	211.94	194.08	290.25	288.22	246.98
Routine insourced capital									
Home	166.35	166.35	166.35	160.11	159.19	89.81	151.39	150.34	53.39
Host	166.35	166.35	166.35	213.16	211.94	297.29	290.25	288.22	449.92
Marginal effective tax rates									
High-tech capital									
Home	0.35	0.35	0.35	0.35	0.45	0.48	0.35	0.46	0.56
Host	0.35	0.35	0.35	0.25	0.13	0.14	0.10	-0.05	–0.10
Routine outsourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Host	0.35	0.35	0.35	0.25	0.25	0.25	0.10	0.10	0.10
Routine insourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.48	0.35	0.35	0.56
Host	0.35	0.35	0.35	0.25	0.25	0.14	0.10	0.10	–0.10

Table 4 (Continued)

Shifting, Tax Revenues and Rents under Separate Accounts and Formulary Apportionment

(Increased Economic Profits)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	Separate Accounts			Separate Accounts			Separate Accounts		
	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment	No Shifting	Shifting	Formulary Apportionment
Profit shifting under Separate Accounts									
Share of high-tech capital in host	0.50	0.50	0.50	0.54	0.61	0.62	0.58	0.66	0.71
Percentage of rents shifted		0.00			0.86			0.94	
Cost of shifting (K^M/total capital)		0.00			0.06			0.07	
Profit split under Formula Apportionment									
Percent of profits allocated abroad			0.50			0.31			0.20
Tax revenue									
Home	141.02	141.02	84.61	144.95	46.67	57.32	150.48	38.48	41.28
Host	28.20	28.20	84.61	21.84	91.77	83.51	9.67	41.53	40.09
Rents	209.52	209.52	209.52	217.32	236.44	238.69	228.23	295.42	294.22
Price	2.74	2.74	2.74	2.54	2.56	2.58	2.31	2.32	2.38
Quantity	176.61	176.61	176.61	197.10	195.79	192.77	228.27	226.44	218.27

Note: In these simulations the demand elasticity for the output of the company is changed from –2 to –1.5. All other parameters are the same and are shown in Table 1.

case. Furthermore, this seeming equivalence is in a model in which an unrealistically large amount of resources are devoted to shifting under SA and more than 90 percent of rents are shifted when the host country has a tax rate of 10 percent.

These simulations indicate that, even when we assume a great amount of shifting under the current system, FA does not seem to have any notable advantage over SA. FA causes a greater widening in the disparities in marginal effective tax rates that result from tax differentials across countries. A greater amount of capital moves to low tax locations. This is true even for high-tech capital which is the vehicle for income shifting under SA. To be sure, SA does motivate expenditures on the financial manipulation of intercompany prices, which have no use under FA. (We assume that there are no planning costs under FA in spite of the valuation and other issues discussed in the paper.) Finally, the simulations indicate that increasing the profit or varying the substitutability parameters did not seem to have a major impact on the relative performance of SA and FA.

Payrolls are origin based like tangible capital, in contrast to sales, and can be expected to lead to similar distortions if used in the formula. But, as discussed below, payrolls have an added feature that companies can exploit. Unlike the required return on equity capital, wage costs are deductible from the pool of taxable income to be apportioned. Adding labor in the low tax location can lower the average tax rate without adding to total taxable income.

C. Are There Alternative Formulas to Split Profits that Dominate FA?

In view of the critical role of "super" profits because of intangible assets and the use of debt to shift income, it makes sense to ask whether there are formulas other than the traditional ones based on capital, payrolls and sales that reduce the type of income manipulation under SA without the distortions under FA. The assignment of debt based on assets, as in the current U.S. rules for calculating allowable foreign tax credits, is a possibility.

We consider a version of the "residual profit split" allocation for the intangible based excess returns to capital. Under this allocation interest paid to unrelated parties would first be added back to consolidated worldwide income. A normal riskless return could then be assigned to each location based on total assets. (Assets could include capitalized R&D performed in the location.) Then a fixed percentage, say 50 percent, of the worldwide excess return is assigned to the parent on the grounds that it is likely to be the main source of superior returns. The remaining excess return could be apportioned using a formula. This kind of procedure would drain most of the pool of the excess income that distorts behavior. Adding capital in a low tax location only earns the normal return plus a share of the reduced pool of excess returns. The final taxable income in each location would be determined by assigning worldwide interest expense to each location based on assets.[13]

[13] Assigning an arbitrary percentage of the excess return to the home country of course creates an incentive for expatriation or "inversion." There are now restrictions on inversions in the Internal Revenue Code. The main issue would be acquisitions of U.S. MNCs by foreign companies based in low tax locations. This would require a toll charge for the transfer of valuable intangibles abroad, as in the present Section 367 of the Internal Revenue Code.

Table 5 reports simulations for a simplified version of this alternative. First, a normal (grossed up) rate of return on the tangible assets in each location is imputed to that location. Then 50 percent of the excess economic profits that remain are allocated to the parent. The final 50 percent is allocated based on the location of the tangible capital.

Comparing the last two columns in Table 5, we can see that this simple alternative substantially reduces the distortions produced by standard FA. The location of capital gets much closer to the no-shifting SA case. For example, the amount of in-house routine capital abroad is about 15 percent lower than under the standard formula when the foreign tax rate is 10 percent. Home country tax revenues go up almost 75 percent and by much more than the reduction in company rents. So it is clearly welfare improving from the point of view of the home country. This simple example illustrates the possibility that there may be some middle ground between FA and SA that is better than either.

IV. REVENUE

An important question for our inquiry into whether FA dominates SA is whether FA could raise more revenue relative to the current SA system. A complete analysis should take into account the welfare losses that result when governments have to rely on more distorting taxes to meet any revenue constraint. We evaluate the revenue consequences of FA using data from surveys of MNCs published by the Bureau of Economic Analysis (BEA) in the U.S. Commerce department, http://www.bea.gov/international/di1usdop.htm, and from the U.S. Treasury corporate tax files for 2004 (the most recent year available). The corporate tax files include the basic corporate tax return, the Form 1120, the Form 1118 in which companies report their foreign income and calculate their foreign tax credit, and the Form 5471, which is filed for each controlled foreign corporation (CFC) of a U.S. parent MNC. The Form 5471 provides each CFC's balance sheet and income statement, its foreign income taxes paid and various intercompany transactions. It is necessary to use both BEA and Treasury data because they have complementary strengths. For example, the parent balance sheet in Treasury Form 1120 is difficult to use because, unlike in the BEA data, the split between foreign and domestic assets is not provided.

The estimates provided here are "static" ones before any behavioral responses are taken into account. These estimates are in no way official Treasury revenue estimates. More realistic estimates would require the addition of behavioral responses of the type discussed elsewhere in this paper. We focus on nonfinancial parents because banks and other financial intermediaries present special problems. The standard formulas are based exclusively on "real" variables like tangible capital and payrolls and therefore are not well suited for financial businesses.

The estimate of the U.S. static revenue gain from U.S.-based MNCs as a result of FA starts with the companies' worldwide consolidated taxable income before corporate tax. This is the same starting point as the estimate for the repeal of deferral and is based on the Treasury tax files. Consolidated worldwide taxable income before corporate tax includes both income that is retained abroad under current law, and therefore not subject to current U.S. tax, and the income that does appear on the U.S. return. For repealing

Table 5

Optimal Capital Stocks and Marginal Effective Tax Rates Under An Alternative Formulary Apportionment Formula

(Base Case Simulations)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA
High-tech capital									
Home	259.85	259.85	259.85	279.94	253.21	264.65	310.40	263.12	274.04
Host	259.85	259.85	259.85	323.01	353.44	339.07	429.78	503.21	471.52
Routine outsourced capital									
Home	226.21	226.21	226.21	225.83	235.51	231.39	224.26	238.36	234.59
Host	226.21	226.21	226.21	300.67	285.32	292.42	429.94	390.10	404.39
Routine insourced capital									
Home	226.21	226.21	226.21	225.83	172.29	194.82	224.26	138.16	158.81
Host	226.21	226.21	226.21	300.67	369.51	337.09	429.94	595.82	525.30
Marginal effective tax rates									
High-tech capital									
Home	0.35	0.35	0.35	0.35	0.41	0.38	0.35	0.46	0.41
Host	0.35	0.35	0.35	0.25	0.18	0.22	0.10	–0.04	0.03
Routine outsourced capital									
Home	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Host	0.35	0.35	0.35	0.25	0.25	0.25	0.10	0.10	0.10
Routine insourced capital									
Home	0.35	0.35	0.35	0.35	0.41	0.38	0.35	0.46	0.41
Host	0.35	0.35	0.35	0.25	0.18	0.22	0.10	–0.04	0.03

Table 5 (Continued)

Shifting, Tax Revenues and Rents under an Alternative Formulary Apportionment Formula

(Base Case Simulations)

	Tax in Host Country=35%			Tax in Host Country=25%			Tax in Host Country=10%		
	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA	SA with No Shifting	FA	Allocate 1/2 of Rents Using FA
Tax revenue									
Home	115.06	76.71	95.88	121.92	64.09	95.07	131.88	54.04	94.84
Host	38.35	76.71	57.53	30.81	71.90	49.81	14.33	36.58	24.58
Rents	142.46	142.46	142.46	153.27	167.80	160.04	169.03	216.69	190.46
Price	1.83	1.83	1.83	1.70	1.70	1.70	1.54	1.54	1.55
Quantity	240.16	240.16	240.16	278.01	276.97	277.14	338.13	338.25	333.78

Note: Parameters used in simulations are shown in Table 1. See text for explanation.

deferral, the revenue estimate then calculates the amount of foreign taxes that can be credited against the tentative U.S. tax liability on this worldwide income. In implementing FA, the worldwide consolidated base is split between the United States and foreign governments based on the formula. In each case, the net revenue gain compared to the revenue under current law is calculated.

We assume that the allocation formula under FA is based exclusively on the amount of real capital in each jurisdiction derived from the net plant and equipment plus inventories figures from the BEA tables for 2004. We use information from the BEA tables that classify affiliate data based on the industry of the parent. Using this classification is important because any income in a tax haven holding company controlled by a nonfinancial parent in manufacturing, for example, is included in worldwide income for the purpose of the formula allocation.

We start with manufacturing parents. The Treasury tax data for 2004 indicates that worldwide taxable income of U.S. parent companies in manufacturing was $444 billion. The share of worldwide net property, plant, equipment and inventories in affiliates abroad is 0.408. Using this ratio to apportion worldwide income results in a net gain of $29.9 billion to the U.S. Treasury. This contrasts with a static gain of $17.4 billion as a result of repealing deferral. For all nonfinancial parents, the gain is $55.3 billion from FA and $28.5 billion from repealing deferral.

The higher revenue paid to the U.S. Treasury from FA compared to the repeal of deferral indicates that the tax credits granted against the worldwide income base under repeal are more important than the share of the worldwide base attributed to foreign governments under FA. In part this is due to the high foreign taxes paid by integrated oil companies, which are included in manufacturing. If oil companies are taken out of manufacturing, the comparison is much closer, an increase in U.S. revenue of $23.7 billion under FA and $17.4 under the repeal of deferral.

Furthermore, the U.S. companies will pay less to foreign governments under FA, by $14.7 billion in nonpetroleum manufacturing. The companies' average effective foreign tax rate goes up by about 5 percentage points but that is more than offset by the shrinkage of the total pool of foreign income. The net overall cost of FA to the companies is therefore much smaller than the net cost of repealing deferral. This simply reflects the fact that under the repeal of deferral, the effective worldwide tax rate is at least 35 percent while under FA the share allocated to foreign jurisdictions is taxed at about a 25 percent rate.

In these static estimates using 2004 data, repealing deferral raises about 40 percent less than FA. But as we have seen, companies have many opportunities for reducing the impact of FA. In contrast, these opportunities are limited if deferral is repealed because all worldwide income is in the U.S. tax base.

Interestingly, the comparable estimates for 1996 indicate a much smaller revenue gain from the adoption of FA. The static gain from manufacturing parents would have been $10 billion, which compares with the hypothetical gain in 2004 of $29.9 billion above. Furthermore, the three-fold increase in the revenue from formula apportionment is not explained by the increased worldwide income of manufacturing parents over the period.

Worldwide income only increased by 52 percent. These estimates for 1996 and 2004 are consistent with the possibility that the "check the box" rules introduced in 1997 had a significant effect on the share of worldwide income located abroad.

V. THE CHOICE BETWEEN ORIGIN AND DESTINATION BASED FORMULAS

Many U.S. states have adopted a sales only formula for apportionment. Putting sales in the formula seems to adopt a destination based concept, unlike payrolls and capital that are more consistent with origin based taxation. It is the location of sales versus the location of production. The choice between the destination and origin basis formula is sometimes described as depending on "where the income is earned." This however is not a very useful way to approach the question. Every transaction requires a buyer and a seller. It is more productive to look at each system and compare their impacts on the pattern of trade, investment and saving. Furthermore, which is more susceptible to manipulation by companies attempting to minimize their tax burden?

In evaluating the impact of a destination based system on trade, it is important to compare the reduction in tax for a dollar of exports with the imposition of tax per dollar of imports. Trade is not distorted if they are equal.

For example, consider two countries trading with each other. One of the countries is high-tech and has a 40 percent tax rate; the other produces routine goods with lower profit rates per unit of sales and has a 10 percent tax rate. Assume that profits margins on sales are equal across industries in a given country. Let us start with an origin based tax. Under these assumptions, the tax does not affect relative prices in each economy and comparative advantage is not distorted. Now switch to a destination or sales based income tax system. Then, in the high-tech country the rebate on exports is much higher than the tax on the routine, low margin, imports. That is the equivalent of an export subsidy. In the low-tech country it has a reverse impact, the equivalent of a tariff, but because the tax rate is much lower it does not offset the trade subsidy. The pattern of trade will be different.

This asymmetry of rebates on exports and taxes on imports can arise in various ways. One economy may be much more capital intensive than the other, so that profit rates per unit of sales are much different. Similarly, the export sector in one country may be much more highly integrated.

A. The Direction of Sales

The above discussion of the effects on trade assumed that companies would not rearrange their activities to avoid the formula tax. They simply increased their required pre-tax rate of return in response to the tax and increased their prices to reflect the new costs. But as in the case of an origin based formula using capital or payrolls, where companies rearrange the location of their production to avoid the tax, a sales based formula induces a rearrangement of the location of sales. A MNC earning economic profits will want to have higher sales in the low tax location even if they have negative pre-tax

profits on the margin. Similarly they will cut back on sales in the high tax country. The pool of income to be split under FA always causes the trouble. Companies will also change the mix of their sales in high and low tax locations, just as they change the mix of high-tech and routine production in an origin based formula. They will increase the sales of marginally profitable, or even unprofitable, goods in low tax locations. They may even acquire routine operations with a local clientele in the low tax country. Conversely companies will cut back on the sales of routine products in high tax locations.[14]

Moreover, the company can completely rearrange the destination of its sales by using intermediary low tax countries. Most large markets for U.S.-based goods are in high tax countries in Europe and Asia. But there are small low tax countries like Ireland and Hong Kong in which independent distributors can be located. The model would therefore have two high tax countries and one low tax country. The high profit U.S. company could export to the other high tax country directly, it could have an affiliate that produces and sells in the high tax market or, wherever production occurs, it could sell to an independent distributor in the low tax location which then resells in all markets. (It could also have a production affiliate in the low tax country that could also use the independent distributor.) The independent distributor in the low tax country just earns a normal return. Its tax liabilities on sales to any market would not reflect any of the U.S. manufacturer's excess economic profits. There would therefore be a clear tax incentive to divert transactions through independent resellers.[15]

In the model described below we simplify and consider only one high tax country. But the qualitative results would be similar. The MNC would use the reseller to supply both high tax country markets if the cost of reselling depended on the share of the market the reseller supplies in each.

As in the case of a capital based system in the simulations, companies have several ways of responding to a sales based formula. Under the tangible capital base, companies can shift more of their routine operations to low tax locations and rely on more outsourcing in high tax countries. Under the sales formula, a company can increase the sales of routine products in low tax locations and sell to unrelated resellers in tax havens. Even if it sold its goods to an unrelated distributor in a low tax country, it could presumably still maintain a marketing operation in the high tax country without incurring a local liability as long as it did not take title to the goods.

It may appear that the destination of sales is easier to establish than the market value of tangible capital. But VAT systems apparently have great problems identifying real exports because of "carrousel fraud" (Keen and Smith, 2006). With a sales based for-

[14] Even without rents, investors in the high tax location have the incentive to export to a low tax location and leave the proceeds abroad where they can accumulate returns at a low tax rate until they want to consume. The firm can effectively generate consumption tax treatment of savings under an income tax.

[15] John Wilson has independently come to a similar conclusion using a somewhat different model (Wilson, 2008). His model has a high-tech intermediate stage and a routine assembly stage earning a normal return. The two stages are not produced by a single integrated firm because the assembly stage is always outsourced to an independent firm in the low tax country. It then exports the final product back to the high tax location.

mula, the problem of identifying the actual destination of sales would be much more difficult since it would be necessary to know to which country the goods were shipped and not just whether they were exported. This is particularly true of Internet downloads which do not pass through any border controls. It is probably easier to identify where the capital and labor producing the digital material are located.

B. Licensing to Related or Unrelated Parties

Consider a company with a valuable intangible asset like a patent that it can either exploit by itself in company-owned plants or license to unrelated parties. Under an origin based formula, if a high tax country is an efficient production location, because of the availability of skilled labor for example, the company has an incentive to license the technology to third parties. That avoids having to assign the labor and capital that would be required in its own subsidiaries to the high tax country in the formula. Similarly it has an incentive to establish its own operations in low tax locations.

In the case of a sales based formula, it is useful to distinguish intangibles that are mobile, in that they can be exploited in any one of many locations to serve a worldwide market, from those in which production has to be close to the ultimate consumers. For market-oriented intangibles, the company has an incentive to license unrelated parties in high tax locations and its own subsidiaries in low tax locations. But for mobile intangibles, the company does not have the opportunities under a sales based formula that it would have under a production based formula. Under a capital or payrolls based formula, the company can choose a low tax location without a significant local consumer base, like Ireland for example. Under a sales based formula, this would have little benefit.

As mentioned above, many states in the United States now use a sales only formula. Perhaps state policy makers think that they can "export" the tax by taxing local sales of out of state companies. Or perhaps they think it acts as an export incentive for their own companies. Both, of course, cannot be true. The outcome depends on what happens to the terms of trade. If the tax on imports exceeds the tax rebate on exports, a large state might benefit from its monopsony power by forcing down the price of imports.

C. Model for Sales Based Formula

We suggest two versions of a simple model to analyze sales based formulas. Full simulations are not presented but the similarity in structure compared to the earlier model will indicate parallel opportunities for tax avoidance behavior. As in the model used in the capital based simulations, there are two countries: Country 1 is a high tax country with corporate tax rate t_1 and Country 2 has corporate tax rate t_2 (where $t_1 > t_2$). Instead of high-tech and routine capital, there are two products, one very profitable good, H, because of a valuable intangible, and one relatively routine low margin good, R. There are separate demands for these two goods in each country. The demand for the routine good is much more elastic than the demand for the high-tech good.

Similar to the earlier model, worldwide production of each good is a function of capital in each country: $Q^H = Q^H(K_1^H, K_2^H)$ and $Q^R = Q^R(K_1^R, K_2^R)$. The demands for the high-tech good in each market are $D_1^H = D(P_1^H)$ and $D_2^H = D(P_2^H)$. There are similar demands for the routine good. We assume that the demands for the high-tech good and the routine good are not related. The prices for a given good can differ between the two markets.

Under SA, there is a separate shifting function for each good. Each shifting function giving the share of economic profits allocated to the low tax country depends as before on the share of that product's capital in the low tax location and on the resources devoted to shifting. K_M^H denotes the resources devoted to shifting economic profits from the high-tech good and K_M^R denotes the resources devoted to shifting economic profits from the routine good. The shifting function for the profits from the high-tech and routine goods respectively are $S^H(K_1^H, K_2^H, K_M^H)$ and $S^R(K_1^R, K_2^R, K_M^R)$. As in the earlier model the cost of income shifting increases as capital in the high tax country increases and decreases as capital in the low tax country is increased: $\partial S^j/\partial K_1^j < 0$ and $\partial S^j/\partial K_2^j \geq 0$ for $j = (H,R)$.

Under SA, the profits of each product are optimized separately. Each optimization solves for the respective Ks, Qs, and resources devoted to income shifting, with the adding up constraint that a particular Q is equal to the sum of the Ds. It is convenient to write demand in terms of P depending on quantity, i.e., $P(Q)$.

Let E_{SA} denote pre-tax rents as in the earlier model. In this case, the returns are generated through sales of the two goods:

$$E_{SA} = E_{SA}^H + E_{SA}^R$$

where $E_{SA}^j = P_1^j(Q_1^j)Q_1^j + P_2^j(Q_2^j)Q_2^j - (K_1^j + K_M^j)(r/1 - t_1) - K_2^j(r/1 - t_2)$ for $j = H,R$. The Lagrangian for the MNC's profit maximization problem for each good j ($j = H,R$) can be written

$$L^j = E_{SA}^j(1 - t_{SA}) + \lambda^j(Q^j(K_1^j, K_2^j) - Q_1^j - Q_2^j)$$

where $t_{SA}^j = (1 - S^j)t_1 + S^j t_2$, $E_{SA}^j(1 - t_{SA})$, equal after-tax returns, and λ^j will turn out to be the marginal cost. In what follows, we suppress the superscripts denoting the type of good for ease of presentation.

The first-order conditions are

$$(7) \quad \frac{\partial L}{\partial Q_1} = \left(P_1 + Q_1 \frac{\partial P_1}{\partial Q_1} \right)(1 - t_{SA}) - \lambda = 0$$

$$(8) \quad \frac{\partial L}{\partial Q_2} = \left(P_2 + Q_2 \frac{\partial P_2}{\partial Q_2} \right)(1 - t_{SA}) - \lambda = 0$$

$$(9) \quad \frac{\partial L}{\partial K_1} = E_{SA} \frac{\partial S}{\partial K_1}(t_1 - t_2) - \frac{r}{1 - t_1}(1 - t_{SA}) + \lambda \frac{\partial Q}{\partial K_1} = 0$$

$$(10)\quad \frac{\partial L}{\partial K_2} = E_{SA}\frac{\partial S}{\partial K_2}(t_1 - t_2) - \frac{r}{1-t_2}(1-t_{SA}) + \lambda\frac{\partial Q}{\partial K_2} = 0$$

$$(11)\quad \frac{\partial L}{\partial K_M} = E_{SA}\frac{\partial S}{\partial K_M}(t_1 - t_2) - \frac{r}{1-t_1}(1-t_{SA}) = 0$$

Solving the first-order conditions shows clearly that tax differences do not distort the distribution of sales across the two countries under SA. The marginal product of capital is equal to the normal grossed up r plus any effect of capital on the distribution of taxable rents. To see this, note that (9) and (10) give the optimal conditions for investment in each country

$$(12)\quad \frac{\partial Q}{\partial K_i} = \left(\frac{1}{P_i + Q_i\dfrac{\partial P_i}{\partial Q_i}}\right)\left(\left(\frac{r}{1-t_i}\right) - \frac{E_{SA}\dfrac{\partial S}{\partial K_i}(t_1 - t_2)}{1-t_{SA}}\right) \text{ for } i = 1,2$$

The marginal cost of investment is lower in the low tax country relative to the high tax country since investment in the low tax country enables the shifting of income from the high tax to the low tax country. Finally, rewriting (11) shows that the optimal amount of capital invested in income shifting depends on the level of pre-tax rents and the tax differential as in the earlier model:

$$\frac{\partial S}{\partial K_M} = \frac{r}{1-t_1}\frac{(1-t_{SA})}{E_{SA}(t_1 - t_2)}.$$

Under FA the profit maximization is combined. The share of total net income allocated to each country will now depend on the distribution of sales across countries. To simplify the model, we first consider a set-up in which the MNC produces only the high margin good, H. The MNC sells the high-tech good in both the high and low tax countries. The share of returns, $P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H$, taxable in the high tax country, α, is defined:

$$\alpha = \frac{P_1^H(Q_1^H)Q_1^H}{P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H}.$$

Total returns after-tax equal $(P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H)(1-\tau) - r(K_1^H + K_2^H)$ where τ is the weighted average tax rate:

$$\tau = \alpha t_1 + (1-\alpha)t_2.$$

The Lagrangian for the MNC's profit maximization problem can be written

$$L = (P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H)(1-\tau) - r(K_1^H + K_2^H) + \lambda(Q(K_1^H, K_2^H) - Q_1^H - Q_2^H)$$

The first-order conditions are

$$(13)\quad \frac{\partial L}{\partial Q_1^H} = \left(P_1^H + Q_1^H \frac{\partial P_1^H}{\partial Q_1^H} \right)(1-t_1) - \lambda = 0$$

$$(14)\quad \frac{\partial L}{\partial Q_2^H} = \left(P_2^H + Q_2^H \frac{\partial P_2^H}{\partial Q_2^H} \right)(1-t_2) - \lambda = 0$$

$$(15)\quad \frac{\partial L}{\partial K_1^H} = -r + \lambda \frac{\partial Q_1^H}{\partial K_1^H} = 0$$

$$(16)\quad \frac{\partial L}{\partial K_2^H} = -r + \lambda \frac{\partial Q_2^H}{\partial K_2^H} = 0$$

Solving the first order conditions shows that marginal revenues in each country i, $(P_i^H + Q_i^H (\partial P_i^H / \partial Q_i^H))(1 - t_i)$, equals marginal cost, λ, which is the same in the two countries. Unlike under SA, optimal investment across the two countries is not distorted by taxes:

$$\frac{\partial Q_1^H}{\partial K_1^H} = \frac{\partial Q_2^H}{\partial K_2^H}.$$

Now assume there is a separate company in the low tax country selling a routine good. For simplicity, assume the company only sells the routine good in the low tax country (it is country specific). The routine good is produced with labor and generates no capital income. Should the MNC acquire the company that produces the routine good? How would after-tax revenues be affected? With FA there is a clear benefit in terms of tax savings of acquiring the routine good producer. While acquiring the production of the routine good has no effect on profits before taxes, it lowers tax payments by reducing the portion of profits taxed in the high tax country. Total returns after-tax become $(P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H)(1-\theta) - r(K_1^H + K_2^H)$ where θ is the new weighted average tax rate. The share of profits taxable at the high tax rate, which we denote β, is less than α since the revenues from the sales of the routine good are now added to the denominator of the allocation formula:

$$\beta = \frac{P_1^H(Q_1^H)Q_1^H}{P_1^H(Q_1^H)Q_1^H + P_2^H(Q_2^H)Q_2^H + P_2^R(Q_2^R)Q_2^R}$$

Acquiring the routine good producer lowers the weighted average tax rate by reducing the share of revenues allocated to the high tax country: $\theta + \beta t_1 + (1-\beta)t_2 < \tau$.

This extreme example shows the conditions under which it is highly profitable to expand or acquire routine sales in the low tax country. One is where the principal market for the routine good is in the low tax country. Another is that the routine good should have modest capital income per unit of sales compared to the high-tech good.

The capital income could be either in the form of excess profits or the normal return to capital. Therefore, since the formula is based on sales, the benefit in terms of a lower average tax rate far outweighs the increased pool of capital income to be apportioned. The company will even be willing to take a loss on the margin in the low tax country because of the tax saving on total taxable income.

The example also illustrates one of the general problems with formula apportionment, the potential asymmetry between the determinants of taxable income and the items that enter into the formula. Intangible assets that increase taxable income but are impossible to measure are one example. But payrolls are another because wage costs are deductible from taxable income. If payrolls are in the formula, companies can exploit the asymmetry by adding labor intensive activities in the low tax country. They would go beyond the normal equality of the marginal productivity of labor with wage costs because of the benefits of the lower tax rate.

Another possibility of restructuring to minimize taxes involves adding a potential unrelated reseller in the low tax country. Consider again our MNC that sells only one type of good. Assume that the marginal cost of trans-shipping, C, rises with the amount of good, Q_t, that is resold: $C = C(Q_t)$. The reseller is only used to satisfy demands in the high tax country. (Resellers are unnecessary for the low tax country demands.) The price of a good is the same in the high tax country whether from a reseller or not. The price through the reseller is the sum of the price paid to the MNC plus the reseller's marginal costs. Unrelated resellers are not used under SA because they add to costs and provide no tax benefit. The optimization under FA solves for the Ks, Qs, and the amount of high tax demand that is purchased from an unrelated reseller. The marginal conditions equate the marginal after tax profit of direct sales in the high tax market with the marginal profit of sales through the unrelated reseller.

Note that in this formulation of our simple model, the price of good in the high tax country is a function of the total quantity of the good sold in the country: $P_1(Q_1 + Q_t)$. Total revenue, TR, is equal to $P_1(Q_1 + Q_t)\,Q_1 + P_1(Q_1 + Q_t)\,Q_t + P_2 Q_2$ and the tax rate, $\hat{\tau}$, is $\hat{\tau} = \hat{\alpha} t_1 + (1 - \hat{\alpha}) t_2$ where

$$\hat{\alpha} = \frac{P_1(Q_1)Q_1}{P_1(Q_1 + Q_t)Q_1 + P_1(Q_1 + Q_t)Q_t + P_2 Q_2 - C(Q_t)}.$$

The Lagrangian for the MNC's profit maximization problem can be written

$$L = (TR - C)(1 - \tau) - r(K_1 + K_2) + \lambda(Q(K_1, K_2) - Q_1 - Q_2)$$

The first-order conditions are

$$(17)\quad \frac{\partial L}{\partial Q_1} = \left(P_1 + (Q_1 + Q_t)\frac{\partial P_1}{\partial Q_1}\right)(1 - \tau) - \left(\frac{\partial \tau}{\partial Q_1}\right)(TR - C) - \lambda = 0$$

$$(18)\quad \frac{\partial L}{\partial Q_2} = \left(P_2 + Q_2 \frac{\partial P_2}{\partial Q_2}\right)(1 - \tau) - \left(\frac{\partial \tau}{\partial Q_2}\right)(TR - C) - \lambda = 0$$

$$(19)\quad \frac{\partial L}{\partial Q_t} = \left(P_1 + (Q_1 + Q_t)\frac{\partial P_1}{\partial Q_t} - \frac{\partial C_1}{\partial Q_t} \right)(1-\tau) - \left(\frac{\partial \tau}{\partial Q_t} \right)(TR - C) - \lambda = 0$$

$$(20)\quad \frac{\partial L}{\partial K_1} = -r + \lambda \frac{\partial Q_1}{\partial K_1} = 0$$

$$(21)\quad \frac{\partial L}{\partial K_2} = -r + \lambda \frac{\partial Q_2}{\partial K_2} = 0$$

The condition for Q_t shows that the company is willing to waste resources on an independent reseller to lower its tax rate. If using an unrelated distributor is not costly, the high tax country suffers a large revenue drain. Consider the extreme case in which the marginal cost of reselling in (19) is zero and compare to the condition for Q_1 in (17). Then the marginal after tax profits of increasing Q_t must always be greater than the marginal after tax profits from increasing Q_1 because $\partial\tau/\partial Q_t$ is negative and $\partial\tau/\partial Q_1$ is always positive. In other words direct sales fall to zero. As in the case without the reseller, the location of capital is not distorted which is clear from inspection of (20) and (21).

The comparison of FA and SA depends on how easy it is to reallocate tangible capital compared to the ease of changing the mix of high margin and low margin sales in a market, and also the extent to which independent resellers can be used. If anything, it would appear that rerouting sales through a reseller would be relatively inexpensive. This is particularly true for services like downloads from the Internet.

VI. EXTENDING THE SIMPLE MODEL

Our models do not explicitly include certain aspects of FA and SA that should be incorporated into any complete evaluation of the two systems. In particular, we have ignored the problem of financial assets and earnings in nonfinancial companies, the treatment of ongoing R&D, and implementation issues.

A. The Treatment of Financial Assets and Earnings

One of the advantages of FA may also be a source of one of its major weaknesses. Under FA, income allocation is based on real variables like tangible capital and payrolls. Income therefore cannot be shifted to tax havens in which there is no real business activity. But that leaves the question of what to do with financial assets and earnings, particularly in nonfinancial companies with a significant financial business.

For the purposes of the formula allocation the U.S. states generally distinguish between "passive income," which is allocated to the state in which the parent company is incorporated, and "business income," which is part of the consolidated pool subject to the normal formula. The exception is traditional stand alone banks that have their

own formulas based on the number of loans and transactions, etc. The passive versus business income distinction obviously raises issues of classification. In any case, many nonfinancial corporations have significant financial operations. Their financial income is included in the consolidated pool of income to be apportioned but the formula is based exclusively on "real" variables like tangible capital and payrolls. Financial assets do not enter in. The financial income therefore plays the same role as supernormal intangible income in causing companies to reallocate real activities in order to reduce worldwide tax liabilities.

Tangible assets in the form of inventories and property, plant and equipment account for only a minority of total assets even in nonfinancial businesses. The U.S. Commerce Department's Bureau of Economic Analysis (BEA) data reveals that, in 2004, inventories and net property, plant and equipment were 25.6 percent of the total assets of parents in manufacturing. This share is calculated after netting equity in foreign affiliates from total assets. Foreign affiliates of these manufacturing parents have an even smaller share, 20.6 percent of total assets, after netting equity in other foreign affiliates, in the form of tangible assets.

The effect of financial income in distorting real decisions under FA contrasts with its role in the current system which provides much fewer opportunities for income shifting other than excess intangible income. Purely passive financial income is currently included in the parent's taxable income under the CFC rules. Furthermore, a significant amount of active financial income is subject to "global dealing" rules which are effectively formulas tailor made for the financial sector.

The ratio of net worldwide net income to total plant, equipment and inventories shows the combined effect of excess intangible returns and the exclusive use of "real" variables in the formula. Combining the BEA data with information from tax returns of U.S. MNCs available from the Treasury Department shows that in 2004 the ratio of net worldwide pre-tax income to tangible capital in manufacturing was 22.6 percent.[16] In pharmaceuticals and computers, two industries with very profitable companies, the ratio was 39.2 percent. Profitability relative to tangible assets of this magnitude provides a strong incentive for companies to readjust their activities to locate more of their excess profits in a low tax location.

B. The Location of the Financial Business under FA

Many major nonfinancial companies have significant financial businesses. Since financial assets do not enter into the allocation formula, the location of the financial business seems independent of tax considerations if only tangible capital counts. But our earlier discussion of welfare considerations indicates that is actually an undesirable outcome. Consider formula apportionment based on capital. The effective tax rate on the financial operation in the high tax country will be too low because it will in part

[16] As explained further in the next section, we combine data from the BEA and the Treasury Department in our calculations since they have complementary strengths.

reflect the tangible capital in the low tax location. The MNC's financial business will therefore have an advantage over independent financial companies. Conversely, the MNC's financial business in the low tax location will have a tax rate that is too high.

C. Current R&D under FA Compared to the Present System

Our models assume an existing intangible asset that allows the company to earn excess returns. They do not include the mechanism by which the intangible is created, which is presumably through prior R&D. But we can relate how current R&D is treated under FA with cost sharing agreements under SA. Under FA, R&D is deductible against worldwide income. The R&D then contributes to the future pool of income which is divided among affiliates based on the activities of the company at that time. It therefore looks like a cost sharing agreement under current practice in which the various components of a worldwide company contribute to the cost of a R&D program and then have the rights to use the technology eventually developed. But it is a cost sharing agreement that gives company planners great opportunities for exploiting a formula.

The major issue in cost sharing agreements is the "buy in," the amount that new participants, that is the foreign affiliates, have to pay to compensate the parent company for its past R&D that the new project builds on. The implementation of FA effectively results in a cost sharing agreement without a "buy in." A new low tax affiliate can benefit from the prior R&D without paying for it, which of course increases the benefits of a low tax location. FA also gives the parent company the incentive to delay establishing a low tax subsidiary until a very promising technology has been developed because it can thereby deduct the cost of the project against highly taxed income. The low tax subsidiary can also start small, paying a small amount of a promising research project, and then expand its production greatly after the product has been developed.

Capitalizing R&D and including it in the asset base would not solve the "buy in" problem. (Capitalizing R&D presumably means that there is no current expensing for R&D.) The large successful high-tech companies are the winners in the R&D race and earn supernormal returns on both their past and current R&D projects. The losers in the race can presumably deduct their "dry hole" costs against domestic taxable income earned on their other products. Capitalizing could also create the additional distortion by causing companies to shift routine development and testing to low tax locations.

D. Problems of implementation

FA seems much simpler than SA and seems to require much less detailed information. However, a variety of implementation issues do arise. First, what businesses are to be included in the worldwide combination? Some states in the United States use FA only for separate corporations, not any combination of related corporations under common ownership (see Martens-Weiner (1999) and Cline (2008) for useful background on how the U.S. states implement formula apportionment). Canada uses that system as well for its provinces. As a result, the system becomes elective because it is sensitive to the pattern of incorporation that the controlling company chooses.

The important choice of FA systems is between a "unitary" system and a "common consolidated base." In the former, an attempt is made to separate businesses within the consolidated group that have no effective relationship with each other. But dividing overhead expenses like interest between the different unitary businesses is not straightforward. The Common Consolidated Base system escapes this problem by combining various types of financial and nonfinancial businesses together. However, it spreads the effect of large profits in one line of business to all other lines. We leave further exploration of implementation issues to future work on the topic.

VII. CAN THE POSITIVE ASPECTS OF FA BE ACHIEVED MORE SIMPLY?

One of the possible sources of revenue and efficiency gain from FA is the (implicit) reallocation of debt as a result of the formula. As noted in the introduction, the allocation of debt is one of the two major sources of income shifting under the current system. But that can easily be addressed within the current system. For example, assigning debt based on total assets in each location, including financial assets, would be an easy step and superior to the indirect allocation that occurs within the formula. The assignment would simply require that all components of the worldwide company have the same debt-asset ratio. In this calculation, intercompany assets, like equity in related parties, do not count. Similarly, only debt incurred with third parties is allocated. If a subsidiary has a branch in another country, there may be a question as to where the entity's financial assets are located for the purposes of the debt allocation. They should be in the country in which the income from the financial assets is reported. The interest on the debt would only be deductible in the country to which it is allocated.[17] This contrasts with the implicit assignment of debt based on sales, payrolls or tangible capital under FA, none of which are as good indicators of how much an affiliate could borrow. The system for allocating debt should, like the transfer pricing system in general, attempt to preserve tax neutrality between MNCs and local national companies.

MNCs ability to shift income, reflected in the income shifting function in our model, is not technologically determined but depends upon the particular regulatory and enforcement regime in place. One indication of the tightness of the current regime is the extent to which income is located in "pure" tax havens without any real operations. This phenomenon has grown substantially for U.S. MNCs since the implementation of the "check the box" rules in 1997. These rules allow companies to avoid the CFC rules and strip income from high tax countries to tax havens. Altshuler and Grubert (2005) have estimated that by 2002, "check the box" had allowed U.S. companies to reduce their foreign tax burdens by 15 percent.

The "check the box" rules also may have promoted greater shifting of income out of the United States.[18] In non-oil manufacturing, for example, the share of total income

[17] This is similar to the "worldwide fungibility" system for interest allocation that went into effect in 2009. But it would affect all companies, not just those with excess foreign tax credits, because it would not work through the foreign tax credit calculation.

[18] The U.S. Treasury proposed to limit the application of "check the box" in 1998, but the proposal never went into effect.

earned abroad by U.S. MNCs increased from 54.6 percent in 1996 to 70.3 percent in 2004. Furthermore, this growth in the share of foreign income was not attributable mainly to the more rapid growth of sales abroad. The profit margin on sales abroad (the ratio of foreign income to sales) increased by 20 percent over this period while at the same time the profit margin on domestic sales declined substantially. While the focus of our revenue estimates is on the most recent data available, 2004, we also present estimates of the revenue gains from the adoption of FA for 1996. These estimates suggest that the "check the box" rules introduced in 1997 may have had a significant effect on the share of worldwide income located abroad. Besides a reexamination of these 1997 regulations, another option for controlling income shifting that seems worth studying is a requirement for a minimal level of real capital or employment in a jurisdiction before any income could be located there.

VIII. CONCLUDING REMARKS

This paper reports results from an analysis of the benefits of FA relative to the current SA system that starts from the observation that the two most significant sources of income shifting are intangible income and debt. We also recognize that a major goal of the transfer pricing or income allocation system is to preserve the tax neutrality between arms length and related party transactions and between multinational and single jurisdiction companies. We present simple models that highlight all of these features. We show that both SA and FA distort behavior but along different margins. Under SA, companies have an incentive to shift high-tech activities and to manipulate transfer prices. Under capital or payrolls based FA, companies do not manipulate transfer prices but they have an incentive to shift routine activities abroad and to change the degree to which they depend on outside suppliers. Sales based formulas, on the other hand, provide companies incentives to alter the mix of high margin and low margin sales in a market, and also the extent to which independent resellers in low tax countries are used.

The simulations of our simple model indicate that the current SA system causes fewer distortions than FA under capital based formulas. FA causes a greater widening in the disparities in marginal effective tax rates that result from tax differentials across countries. As a result, more capital moves to low tax locations under FA. This is true even for high-tech capital which is the vehicle for income shifting under SA. While SA induces expenditures on financial manipulation of intercompany prices, which have no use under FA, this does not give any decisive advantage to FA even when we assume that these planning expenditures are very large and almost all of economic profits are shifted to the low tax location.

We also examine the complicating role of financial assets under FA and how ongoing R&D is implicitly allocated. Formulas different from the conventional ones are also discussed, for example, first dealing with debt separately and allocating it based on total assets. The conceptual basis for the conventional formulas are discussed, particularly ones based on sales. Finally the effect of FA on the tax liabilities of U.S. MNCs is estimated for 1996 and 2004.

Our analysis illustrates one of the general problems with formula apportionment, the potential asymmetry between the determinants of taxable income and the items that enter into the formula. Intangible assets that increase taxable income but are impossible to measure are one example. Payrolls are another because wage costs are deductible from taxable income. If payrolls are in the formula, companies can benefit from a lower tax rate by exploiting the asymmetry and adding labor intensive activities in a low tax country. They would go beyond the normal equality of the marginal productivity of labor with wage costs.

Our analysis can be extended in a number of directions. For example, the model could take into account the possibility of licensing production that generates excess returns to third parties. The question is how FA and SA affect the choice between licensing a related or unrelated party abroad. In addition, it would be interesting to further explore whether the positive aspects of FA can be achieved within the current system. Finally, implementation problems deserve careful consideration.

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REFERENCES

Altshuler, Rosanne, and Harry Grubert, 2005. "The Three Parties in the Race to the Bottom: Host Governments, Home Governments and Multinational Corporations." *Florida Tax Review* 7 (3), 137–209.

Avi-Yonah, Reuven S., and Kimberly A. Clausing, 2007. "Reforming Corporate Taxation in a Global Economy: A Proposal to Adopt Formulary Apportionment." Hamilton Project Discussion Paper. Brookings Institution, Washington, DC.

Cline, Robert, 2008. "Combined Reporting: Understanding the Revenue and Competitive Effects of Combined Reporting." Newsletter. Council on State Taxation (COST), Washington, DC.

Eggert, Wolfgang, and Guttorm Schjelderup, 2005. "Corporate Tax Systems and Cross Country Profit Shifting: Formula Apportionment vs. Separate Accounting." Unpublished manuscript. University of Paderborn, Paderborn, Germany.

Gordon, Roger H., and John Douglas Wilson, 1986. "An Examination of Multijurisdictional Corporate Income Taxation under Formula Apportionment." *Econometrica* 54 (6), 1357–1373.

Grubert, Harry, 2003. "Intangible Income, Intercompany Transactions, Income Shifting, and the Choice of Location." *National Tax Journal* 56 (1), 221–242.

Grubert, Harry, and Rosanne Altshuler, 2008. "Corporate Taxes in the World Economy: Reforming the Taxation of Cross-Border Income." In Diamond, John W. and George R. Zodrow (eds.), *Fundamental Tax reform: Issues, Choices and Implications*, 319–354. MIT Press, Cambridge, MA.

Keen, Michael, and Stephen Smith, 2006. "VAT Fraud and Evasion: What Do We Know and What Can Be Done?" *National Tax Journal* 59 (4), 861–887.

Martens-Weiner, Joann, 1999. "Using the Experience in the U.S. States to Evaluate Issues in Implementing Formula Apportionment at the International Level." OTA Working Paper No. 83. U.S. Department of Treasury, Office of Tax Analysis, Washington, DC.

Martens-Weiner, Joann, 2006. *Company Tax Reform in the European Union: Guidance from the United States and Canada on Implementing Formulary Apportionment in the EU*. Springer, New York, NY.

McLure, Charles E., Jr., 2007. "Harmonizing Corporate Income Taxes in the European Community: Rationale and Implications." In Poterba, James M. (ed.), *Tax Policy and the Economy*, *Volume 22,* 151–195. National Bureau of Economic Research, Cambridge, MA.

Mutti, John, and Harry Grubert, 2006. "New Developments in the Effects of Taxes on Royalties and the Migration of Intangible Assets Abroad." Paper prepared for the Conference on International Service Flows, sponsored by National Bureau of Economic Research, April 28, Washington, DC.

Nielsen, Søren Bo, Raimondos-Møller, Pascalis and Guttorm Schjelderup, 2003. "Formula Apportionment and Transfer Pricing Under Oligopolistic Competition." *Journal of Public Economic Theory* 5 (2), 419–437.

Nielsen, Søren Bo, Raimondos-Møller, Pascalis, and Guttorm Schjelderup, 2010. "Company Taxation and Tax Spillovers: Separate Accounting versus Formula Apportionment." *European Economic Review* 54 (1), 121–132.

U.S. Department of Commerce, Bureau of Economic Analysis, 2005. "U.S. International Services: Cross-Border Trade in 2004 and Sales Through Affiliates in 2003," Survey of Current Business, October, 78–109.

Wilson, John D., 2008, "Formula apportionment based on sales: An example," Unpublished manuscript. Michigan State University, East Lansing, Michigan.