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International Burdens of the Corporate Income Tax

William C. Randolph (email: william.randolph@cbo.gov)
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Abstract¹

This study applies a simple two-country, five-sector, general equilibrium model based on Harberger (1995, 2006) to examine the long-run incidence of a corporate income tax in an open economy. In equilibrium, capital is assumed to be perfectly mobile internationally in the sense that the country in which a real investment is located does not matter to the marginal investor. In addition, each country is assumed to produce at least some tradable corporate goods for which the country cannot affect world output prices. Like the original Harberger (1962) model, the worldwide stock of capital and the supply of labor in each country are fixed. Under those assumptions, the model provides closed form solutions and easily understood predictions about its comparative static equilibria. As with any simplified model, the analysis is silent about some potentially important issues – such as the effect of the corporate tax on savings, growth and other dynamics – that may also have important effects on corporate tax incidence.

The analysis shows how the domestic owners of capital can escape most of the corporate income tax burden when capital is reallocated abroad in response to the tax. But, as in Bradford (1978), capital owners worldwide cannot escape the tax. Reallocation of capital abroad drives down the personal return to investment so that capital owners worldwide bear approximately the full burden of the domestic corporate income tax. Foreign workers benefit because an increased foreign stock of capital raises their productivity and their wages. Domestic workers lose because their productivity falls and they cannot emigrate to take advantage of higher foreign wages. Under basic assumptions of the numerical application, the outcome is also similar to the implications of the simpler model of Bradford in that the full worldwide burden falls on domestic owners of productive inputs. That outcome changes, however, under alternative assumptions.

Burdens are measured in a numerical example by substituting factor shares and output shares that are reasonable for the U.S. economy. Given those values, domestic labor bears slightly more than 70 percent of the burden of the corporate income tax. The domestic owners of capital bear slightly more than 30 percent of the burden. Domestic landowners receive a small benefit. At the same time, the foreign owners of capital bear slightly more than 70 percent of the burden, but their burden is exactly offset by the benefits received by foreign workers and landowners. To the extent that capital is less mobile internationally, domestic labor's burden would be lower and domestic capital's burden would be higher. Burdens can also be affected by the domestic country's ability to influence the world prices of some traded corporate outputs. But the signs and magnitudes of those effects on burden depend upon the relative capital intensities of production in the corporate sectors that produce internationally tradable goods.

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I. Introduction

In a closed economy, the corporate income tax causes production to be inefficient because the tax is not imposed equally on the income from all capital used in the corporate and noncorporate sectors. That difference causes the capital intensity of production to be too low in the corporate sectors and too high in the noncorporate sectors. The corporate tax is inefficient because the marginal pre-tax return from corporate investment exceeds the marginal pre-tax return from noncorporate investment in equilibrium.²

It is not as clear who bears the long-run burden of the corporate tax in a closed economy.³ But in one of the best-known analyses in public finance, Harberger (1962) found that the U.S. corporate tax is likely to be borne entirely by all owners of capital. How that might occur can be understood, roughly, in terms of the effects that the tax has on output and input substitution decisions made by consumers and producers.⁴ In the Harberger model of a closed economy, the total supplies of labor and capital are fixed but perfectly mobile between sectors. In response to the tax, consumers substitute away from the more heavily taxed corporate goods so that production shifts to the noncorporate sector. Corporate producers substitute away from the taxed input – corporate capital – which pushes up the capital intensity of production in the noncorporate sector, thus reducing the after-tax return to capital.

Under assumptions considered reasonable for the U.S. economy, Harberger (1962) found that the output and input substitution decisions combine in such a way that personal capital

² There are also other sources of inefficiency under the corporate tax (see Gravelle, 1994; Congressional Budget Office, 2005b; and Judd, 2006).

³ In the short run, changes in the corporate income tax are most likely borne by existing corporate shareholders (see Auerbach, 2005).

⁴ Rosen (2002), pp. 294-299, and Fullerton and Metcalf (2002), pp. 1812-1815, provide detailed discussions of the Harberger model.

income is reduced exactly by the full burden of the corporate tax, and wages remain constant. Personal capital income is reduced to the same degree regardless of whether the capital owners invest in the corporate sector or the noncorporate sector.

The effects of the corporate income tax in an open economy are obviously more complicated. The tax is likely to be even less efficient because it can distort both the domestic and the international allocations of capital. Domestic workers are more likely to bear a burden because workers cannot move readily between countries. Domestic wages will fall when capital is reallocated abroad and domestic workers cannot move to take advantage of a higher foreign wage rate. At the same time, foreign labor receives a benefit from the increase in foreign capital. The open economy is difficult to analyze because labor and capital owners can be domestic or foreign, and each sector of each economy can produce goods and services that are traded or not traded internationally. A domestic corporate tax can affect the domestic and foreign prices of inputs and outputs, the domestic and foreign national incomes, and the domestic and foreign distributions of income. The world economy simply has more dimensions.

Melvin (1982) examines a world economy in which there is international trade but no international investment. He finds that the domestic burden of the corporate income tax falls primarily on the factor that is used most intensively in the corporate sector. In the United States, that factor is labor. His model divides the world into two countries that each produce the same two internationally traded goods. The supplies of labor and capital are fixed and immobile internationally. He assumes initially that the domestic economy is small so that domestic economic decisions cannot affect the world prices of traded goods.

Under those assumptions, a domestic tax imposed on capital income in the corporate sector causes the domestic economy to shift production toward the noncorporate sector. If the corporate sector is more labor-intensive than the noncorporate sector, both the corporate and the noncorporate domestic sectors become less capital-intensive in equilibrium as a result of producer responses to the tax. At a lower capital intensity, the return to domestic capital actually increases and domestic labor can bear more than 100 percent of the corporate income tax. Even if the domestic economy is large enough to affect the world prices of the traded goods, Melvin finds that the corporate tax burden still falls primarily on the factor that is used most intensively in the corporate sector.

Melvin's analysis shows that the corporate tax burden can be shifted to domestic labor even when there is no international investment, and even when the domestic economy is large enough to influence the prices of internationally traded goods. However, those results are not fully robust to the addition of internationally mobile capital, the production of goods that are not traded internationally, and the possibility of imperfect demand substitution between domestic- and foreign-produced internationally tradable goods. Unfortunately, trying to account for all of those issues can make the analysis very difficult.

Gravelle and Smetters (2006) construct a computable general equilibrium model in which the world is divided into two countries with four productive sectors in each country. The domestic economy is divided into corporate and noncorporate sectors, like the original Harberger (1962) model, but each sector is further subdivided into a subsector that produces internationally tradeable goods and a sub-sector that produces goods that are not traded between countries. Like Mutti and Grubert (1985), Gravelle and Smetters allow for the possibility that capital is not

perfectly mobile internationally, and for the possibility that foreign and domestic tradable goods are imperfect substitutes in consumption.⁵

Gravelle and Smetters find that the corporate tax burden imposed on domestic labor is small when the demand substitutability between domestic and foreign tradable goods is low. Although their model is different from Melvin's model, their trade result is similar to that earlier finding: The burden imposed on domestic labor can be reduced when the domestic country can influence the world prices of internationally traded goods. In Melvin, that international market power is large when the domestic economy is large compared with the rest of the world. In Gravelle and Smetters, the international market power is large when there is a low degree of substitutability between the domestic and foreign tradable corporate goods. Even a small country can have the latter type of market power. In both models, the corporate tax can affect both domestic and foreign national welfare in ways that operate, in part, like an ad valorem tariff on exports, as illustrated in Whalley (1980).

When international capital mobility is perfect and the substitutability between domestic and foreign corporate tradable goods is very high, Gravelle and Smetters find that domestic labor's burden equals about 73 percent of corporate tax revenue.⁶ Although the foreign capital owners' burden equals 67 percent of the domestic revenue, that burden is fully offset by a benefit that foreign workers receive because they become more productive. Thus, none of the net burden is exported to foreigners. However, domestic labor's share of the burden can be much smaller and a net burden can be exported when the tradable goods are less substitutable. For example, when the aggregate trade substitution elasticity equals 1, a value that Gravelle and

⁵ The Gravelle and Smetters model is very similar to the model constructed by Mutti and Grubert, although Mutti and Grubert do not measure labor's incidence of the corporate income tax.

⁶ Gravelle and Smetters (2006), Table 2.

Smetters cite as reasonable based on previous empirical studies, domestic labor's burden equals only 21 percent of the corporate tax revenue. That reduction of 52 percent in domestic labor's burden is almost all exported to foreign residents, whose net burden then equals 49 percent of the domestic corporate tax revenue. If trade substitution and capital mobility are both low, domestic labor will bear almost none of the corporate income tax burden.

In addition to demonstrating the potential importance of international market power, Gravelle and Smetters show that the long-run incidence of the corporate income tax is highly uncertain. Although empirical evidence about the short-run degrees of international trade substitution and capital mobility suggest that domestic labor bears almost none of the burden of the corporate tax according to their analysis, it is not clear what should be assumed about those parameters for the long run.

Harberger (1995) measures the open-economy incidence of the corporate income tax by analyzing a simple general equilibrium model of domestic and foreign economies that each have five sectors. In contrast to Gravelle and Smetters, the corporate sector that produces internationally tradeable goods is further subdivided into two subsectors. One of those subsectors produces goods that are perfect substitutes for the goods produced by the corresponding foreign sector. The second corporate subsector produces goods that are imperfect substitutes for goods produced by the corresponding foreign sector. Otherwise, that earlier model in Harberger (1995) and later analyzed in Harberger (2006) has the same basic structure as the model in Gravelle and Smetters.

When goods are produced in both corporate tradable goods subsectors of the Harberger (1995) model, the domestic and foreign wages are determined fully by the effects that the tax has

on production costs within the first subsector. In the domestic economy, the corporate tax drives a wedge into the cost of production in the corporate sectors. Because the domestic economy cannot affect the world price of output in the first sector, the domestic wage must decrease in order to offset the increased corporate cost of capital.

Although the Harberger (1995) model splits the corporate tradable sectors in that way, the level of substitutability between the domestic and foreign outputs of the second corporate tradable sector can still affect the incidence of the tax, as in Gravelle and Smetters. But, as shown in this study, that trade effect depends upon the relative capital intensities of production in the corporate tradable sectors. When the capital intensities are equal, the incidence of the tax does not depend at all upon the degree of international output substitutability in the second corporate tradable sector.

This study examines a version of Harberger's (1995, 2006) open-economy general equilibrium model. After developing the model and analyzing the economic effects of the corporate income tax, a numerical application is presented that uses output and input share assumptions reasonable for the United States. The application starts with an assumption that capital is perfectly mobile internationally. It also assumes initially that the degree of international output substitutability does not matter because the corporate tradable sectors have equal output capital intensities. Those assumptions are relaxed later in the application.

This study examines corporate tax incidence both alone and in comparison to several replacement taxes: a general tax on the income from capital in all domestic sectors, a domestic wage tax, a tax on the worldwide capital income of the domestic owners of capital, and a uniform domestic tax on personal income or consumption. The model is also used to examine

the international burdens of the corporate income tax under alternative assumptions: about whether the country is a net international borrower or net international lender, about the relative capital intensities of production in the corporate tradable sectors, about the size of the domestic economy relative to the rest of the world, and about the degree of international capital mobility. A later section also examines how the tax burdens are affected when many countries impose corporate income taxes and may engage in international tax competition. An appendix further examines Harberger (1995), Harberger (2006), and Gravelle and Smetters.

II. The Model

The world consists of two countries. In an initial equilibrium, both economies are identical except for size. For each economy, production is divided into five sectors that each produce goods or services using labor, capital, and (for agriculture) land. All production technologies are characterized by constant returns to scale; production functions are twice-differentiable and concave; competition is perfect at the level of the producer.

The first three sectors are corporate. Sector one produces internationally tradeable outputs for which the foreign and domestic products are perfect demand substitutes. The output from that sector is the numeraire. Sector two produces internationally tradeable outputs for which the foreign and domestic products are not perfect demand substitutes. Sector three produces non-internationally tradable outputs for which consumption must occur in the same country as production; examples include utilities and transportation services.

Sectors four and five are noncorporate sectors. Sector four produces internationally tradeable agricultural products. Sector five produces outputs that are not internationally tradeable, such as residential housing and retail services.

Labor is homogeneous and perfectly mobile within each country, but cannot move between countries. Thus, the wage rate is the same for every sector within a country, but can differ between countries. Individuals do not vary their amount of labor supplied to the market.

The worldwide supply of capital is fixed but perfectly mobile between countries in that the geographic location of investment does not matter to a marginal investor. The marginal return to investment is the same everywhere in equilibrium, excluding producer-level taxes on capital income. Capital owners can own capital in either country, but cannot themselves relocate abroad. Each owns a fixed share of the world capital stock.⁷

Consumers have identical homothetic preferences and must consume where they live. They can choose from among the five types of outputs produced in their own country (or imported from the other country in the case of outputs from sectors one and four) and imports of the unique output from sector two of the other country. Initial consumer expenditures on the six types of goods and services are proportional to the initial shares of worldwide production.

The domestic government collects taxes and makes lump-sum distributions. In order to isolate the effects of the corporate income tax, the government's other policies are assumed to affect neither economic efficiency nor the distribution of income. With any available tax revenues, the domestic government purchases the six available varieties of consumer goods according to the same expenditure shares as domestic consumers. The government redistributes

⁷ The analysis thus abstracts from the effects that the corporate tax may have on tax incidence through its effect on individual savings, the capital stock, and, ultimately, labor productivity and the return to capital (see Fullerton and Metcalf, 2002, pp. 1832-1844).

that bundle of commodities to domestic residents in proportion to their incomes. The foreign government does not respond to any tax policies chosen by the domestic government.⁸

III. The Corporate Income Tax

Starting in a world equilibrium with no corporate taxes, the domestic government introduces a small tax on capital income from domestic production within the corporate sectors. The tax is imposed at a tax-exclusive rate of τ_c percent. That is the percentage by which the tax initially increases the corporate cost of capital above its initial equilibrium value r , so that the corporate cost of capital equals $r \cdot (1 + \tau_c)$. The equilibrium value of r can change as a result of the economic responses to the tax. In a new equilibrium, starting from a tax rate of zero, the corporate cost of capital increases by $\hat{r} + (1 + \hat{r})\tau_c$ percent, where a circumflex over a variable indicates the percentage by which that variable changes to its new equilibrium value. The equilibrium cost of capital outside the domestic corporate sector changes by \hat{r} percent.

Competition in sector one determines how changes in the cost of capital affect the foreign and domestic wage rates in equilibrium. Because the production technology is characterized by constant returns to scale and because competition is perfect at the producer level, any changes in the prices of output in each sector must be related proportionally to changes in the cost of inputs.⁹ For sector one, that relationship is given by:

⁸ A later section of this paper, in an examination of tax competition, discusses how the results apply when other countries also have corporate income taxes and may change their taxes simultaneously.

⁹ Fullerton and Metcalf (2002) show how such comparative static log-linear equilibrium relationships can be derived for a two-sector closed economy under the assumptions of this model. The expression used here for the percentage change in the cost of capital in the taxed sector differs slightly from their corresponding term, $\hat{r} + \tau$, because the term in (1a) allows for a discrete finite change in the tax rate. The term used in (1a) converges to the term used by Fullerton and Metcalf as the tax rate approaches zero.

$$(a) \quad \hat{p}_1^d = 0 = \theta_{L1} \hat{w}^d + \theta_{K1} \cdot [\hat{r} + (1 + \hat{r}) \tau_c]$$

(1)

$$(b) \quad \hat{p}_1^f = 0 = \theta_{L1} \hat{w}^f + \theta_{K1} \hat{r}$$

where p_1^j is the output price, θ_{L1} and θ_{K1} are the labor and capital shares of value added in sector one, and w^j is the wage rate in country j (which can indicate d , domestic, or f , foreign).

The price of sector one output remains constant because sector one produces the numeraire, and the foreign and domestic outputs from that sector are identical. Thus, any change in the cost of capital for sector one in country j must be fully offset by a wage rate change in that country.

Recognizing that the output price does not change, re-arrangement of (1a) and (1b) yields the following equations for the equilibrium changes in domestic and foreign wage rates:

$$(a) \quad \hat{w}^d = - \frac{\theta_{K1}}{\theta_{L1}} \cdot [\hat{r} + (1 + \hat{r}) \tau_c]$$

(2)

$$(b) \quad \hat{w}^f = - \frac{\theta_{K1}}{\theta_{L1}} \hat{r}$$

According to (2a), any increase in the domestic corporate cost of capital for sector one will cause the domestic wage rate to fall. According to (2b), any decreases in the foreign cost of capital for sector one will cause the foreign wage rate to rise. The sizes of those wage rate changes will depend upon the capital intensity of sector one production and the amount of change in the corporate cost of capital. When the capital intensity of sector one production is lower, the wage rate does not have to change by as much for the resulting change in wage costs to fully offset the change in the cost of capital.

The fact that the tax causes the relative prices of the capital and labor inputs to change implies that producers will substitute between their demands for capital and labor. That input substitution causes the equilibrium demands for capital and labor to change according to

$$\begin{aligned}
 (a) \quad & \hat{K}_C^d - \hat{L}_C^d = \sigma_C^d \cdot [\hat{w}^d - \hat{r} - (1 + \hat{r})\tau_c] \\
 (3) \quad (b) \quad & \hat{K}_N^d - \hat{L}_N^d = \sigma_N^d \cdot (\hat{w}^d - \hat{r}) \\
 (c) \quad & \hat{K}^f - \hat{L}^f = \sigma^f \cdot (\hat{w}^f - \hat{r})
 \end{aligned}$$

where K_i^j and L_i^j are the capital and labor stocks and σ_i^j is the partial elasticity of substitution between capital and labor in sector i of country j .¹⁰

Together, the relationships in (2) and (3) determine the equilibrium change in r . Recall that the aggregate supply of labor is fixed in each country and that the supply of capital is fixed worldwide. Based on those conditions, assuming that the input substitution elasticities are identical in all sectors and countries, (2) and (3) imply that the change in the equilibrium r is given by (4).¹¹

$$(4) \quad \hat{r} = -\tau_c \cdot \frac{K^d - \theta_{L1} K_N^d}{K + (K^d - \theta_{L1} K_N^d)\tau_c}$$

Equation (4) implies that the change in r is determined by the relative size of the domestic economy and the size of the domestic corporate sector. When the domestic corporate sector is small compared with the rest of the world economy, the equilibrium value of r will

¹⁰ For capital and labor demands, the subscripts C and N represent aggregate amounts for all corporate sectors and noncorporate sectors, respectively. The absence of a subscript represents an aggregate over all sectors. The absence of a superscript represents an aggregate over both countries.

¹¹ Equation (4) can also be expressed in terms of the input shares alone. It would be easy to derive a variation of equation (4) that allows the corporate and noncorporate sectors to have different input substitution elasticities.

decrease by only a small percentage. In the limit, r will not change when the domestic economy or corporate sector is very small, so the cost of capital in the domestic corporate sector, $r \cdot (1 + \tau_c)$, will increase by approximately τ_c percent. Conversely, when the domestic corporate sector is very large compared with to the world economy, r will decrease by a large percentage, and the cost of capital in the domestic corporate sector will increase by substantially less than τ_c percent.¹²

As a basic economic interpretation of (4), when the relative cost of capital increases in the domestic corporate sectors and decreases in the domestic noncorporate sectors and abroad, domestic corporate producers demand relatively less capital. The noncorporate domestic producers and all foreign producers demand relatively more capital. As a result, the capital intensities of production increase in those latter sectors and the marginal productivity of capital decreases in those sectors. Such changes cause the marginal return to investment, r , to fall in those other sectors.¹³ The marginal return falls by more when the domestic economy and the domestic corporate sector are larger relative to the rest of the world. That happens because any given percentage reduction in the domestic corporate capital stock corresponds in that case to a larger increase in capital/labor ratios of the domestic noncorporate and foreign sectors.

The capital intensity of production in sector one enters (4) because any reallocation of capital out of the domestic corporate sector is offset, somewhat, by the fact that the domestic wage rate falls whereas the foreign wage rate rises. As a result, the domestic noncorporate producers do not increase their demand for capital by as much, proportionally, as do the foreign

¹² When the domestic corporate sector makes up the entire domestic economy and the tax rate is very small, equation (4) is the same as a relationship derived by Bradford (1978) and Kotlikoff and Summers (1986). That variant is discussed in a later section of this study.

¹³ In derivation of (4), the equilibrium conditions are met through changes in the capital allocations alone. The model implies that the labor demands do not change in response to the tax.

producers. The domestic noncorporate producers will even decrease their demand for capital if the domestic economy is very small relative to the rest of the world or if production in sector one is very capital intensive. The importance of such a reaction by the domestic noncorporate producers is represented in (4) by the interaction between the domestic noncorporate capital stock and the term that represents labor's share of value added in sector one.

Changes in the land rents are determined in sector four, the agricultural sector. Following Harberger (1995), it is assumed here that the domestic country does not produce enough to affect the world price of output in that sector.¹⁴ Because sector four uses labor, capital, and land in production, any changes in the net costs of capital and labor are offset by changes in the land rents. The changes in domestic and foreign equilibrium land rents are derived from the relation between input costs and output prices in sector four, as represented by:

$$(5) \quad \hat{p}_4^j = 0 = \theta_{L4} \hat{w}^j + \theta_{K4} \hat{r} + \theta_{\ell 4} \hat{\ell}^j \quad j = d, f$$

where ℓ^j is the land rent in country j and $\theta_{\ell 4}$ is land's share of value added in sector four.

Because the price of sector four output does not change, the change in the domestic and foreign land rents is derived from (5) as:

$$(6) \quad \hat{\ell}^j = - \left(\frac{\theta_{L4}}{\theta_{\ell 4}} \cdot \hat{w}^j + \frac{\theta_{K4}}{\theta_{\ell 4}} \cdot \hat{r} \right) \quad j = d, f$$

¹⁴ The additional fixed factor, land, is included in the model as an input in sector four to avoid a corner solution. Otherwise, when responses to the corporate tax drive down both the wage and the cost of capital for that sector, all domestic producers would want to produce only that output.

The domestic land rent increases in response to the corporate income tax because the tax causes a decrease in both the cost of labor and the cost of capital used by the noncorporate producers. In contrast, the foreign land rents can rise or fall depending on how the capital intensity of production in sector four compares with the capital intensity of production in sector one. Because the size of the increase in foreign labor costs and decrease in foreign capital costs are consistent with a constant price of sector one output, foreign land rents will increase or decrease depending on whether sector four production is less or more capital-intensive than sector one production.

Output prices change in sectors two and three, the other corporate sectors, according to:

$$(7) \quad \begin{aligned} (a) \quad \hat{p}_i^d &= \theta_{Li} \hat{w}^d + \theta_{Ki} \cdot [\hat{r} + (1 + \hat{r}) \tau_c] \\ (b) \quad \hat{p}_i^f &= \theta_{Li} \hat{w}^f + \theta_{Ki} \hat{r} \end{aligned} \quad i = 2,3$$

For both domestic and foreign producers in sectors two and three, the input prices change by the same percentages as the input prices faced by producers in sector one. Because the domestic wage rate falls and the domestic corporate cost of capital rises, the domestic prices of output in sectors two and three will increase or decrease depending upon whether production in those sectors is more or less capital-intensive than production in sector one. In the foreign country, the prices of outputs from sectors two and three have the reverse relationship to the capital intensity of production in sector one because the foreign wage rate goes up and the foreign cost of capital goes down by the same amounts in all sectors. The foreign output prices in sectors two and three will therefore increase if production in those sectors is less capital-intensive than production in sector one. Those foreign prices will decrease if production in those sectors is more capital-intensive than production in sector one.

For both countries, the price changes for the outputs of sector five are given by:

$$(8) \quad \hat{p}_5^j = \theta_{L5} \hat{w}^j + \theta_{K5} \hat{r} \quad j = d, f$$

The price of the domestic output of sector five will decrease because the domestic noncorporate costs of both labor and capital inputs fall. The foreign price of the output of sector five behaves in the same way as the foreign output prices for sectors two and three: Whether the foreign price of sector five output will decrease or increase depends on whether production in sector five is more or less capital intensive than production in sector one.

IV. Tax Burdens

Because individuals consume all of their incomes and because the individual supplies of labor and capital are fixed, the total burden of the corporate income tax can be measured in terms of the changes it causes to personal incomes, adjusted for any welfare effects of changes in the relative prices of consumer goods. For the residents of each country, personal income can be decomposed as in (9), where the initial value of domestic output is arbitrarily set equal to 1:

$$(9) \quad Y^j = w^j L^j + r \delta^j K + \ell^j = Y_L^j + Y_K^j + Y_\ell^j \quad j = d, f$$

where $Y_L^j = \theta_L \cdot \frac{K^j}{K^d}$, $Y_K^j = \theta_K \cdot \delta^j \cdot \frac{K}{K^d}$, and $Y_\ell^j = \theta_\ell \cdot \frac{K^j}{K^d}$ are the amounts of income paid to the resident owners of income from labor, capital, and land, respectively, in country j .

The term δ^j is the share of the worldwide capital stock owned by residents of country j , and θ_L , θ_K , and θ_ℓ are the initial aggregate output shares for labor, capital, and land, respectively. The

total burden of the tax is expressed in terms of changes in personal wage income, capital income, labor income, and the prices of consumer goods as:

$$(10) \quad B^j = -d\left(\frac{Y^j}{P^j}\right) = -Y_L^j \hat{w}^j - Y_K^j \hat{r} - Y_\ell^j \hat{\ell}^j + \hat{P}^j Y^j \quad j = d, f$$

where P^j , initially equal to 1, is an index of the cost of living in country j .

The interaction between personal income and the change in the price index in the last term of (10) accounts for a consumer burden that results from changes in the relative prices of consumer goods. Tax burden is defined here as an equivalent variation, so the price index measures the equivalent variation in consumer expenditure when consumer prices change. The index accounts for changes in the relative prices of consumer goods and any consumer substitution that occurs in response to those price changes. That true cost-of-living index can be approximated by the change in a fixed-share Laspeyres price index:

$$(11) \quad \hat{P}^j \approx \sum_{i=1}^5 s_i \hat{p}_i^j + s_6 \hat{p}_2^{-j} \quad j = d, f$$

where s_i is the initial expenditure share for consumer good i , the j superscript represents the country of residence, and the $-j$ superscript represents the other country.¹⁵

Equation (10) shows how the total burden can be decomposed according to the sources and uses of income. That decomposition is consistent with the way that tax incidence is measured in Harberger (1962) and Harberger (1995). If consumers have identical homothetic preferences and if they face the same changes in consumer prices, the effect of the tax on the

¹⁵ The numerical applications in this study use the Laspeyres index, which can cause the estimated excess burdens of the tax to be overstated. That bias disappears when the tax rate is very small, in which case the excess burden of the tax also approaches zero.

distribution of income is independent of the consumer's burden. For example, the change in real domestic labor income, expressed as a fraction of real domestic income, is independent of the consumer's burden.¹⁶

Alternatively, the consumer's burden can be divided between the owners of each factor according to (12), which combines the effects of the tax on the sources and uses of income.

$$(12) \quad B^j = -Y_L^j \cdot (\hat{w}^j - \hat{P}^j) - Y_K^j \cdot (\hat{r} - \hat{P}^j) - Y_\ell^j \cdot (\hat{\ell} - \hat{P}^j) \quad j = d, f$$

Those combined measures of burden have a clear intuitive economic interpretation that does not depend on the choice of a numeraire. Defined in that way, burden can be thought of as the change in consumption by the owners of each input. For the owners of each factor, it measures the size of a lump-sum tax toward which those owners would be indifferent.

Consistent with Harberger (2006) and Gravelle and Smetters (2006), the combined measures of burden in (12) are used throughout the rest of this study. In addition to having a clear welfare interpretation, the combined measures are needed in order to make international comparisons between the burdens imposed on domestic and foreign residents. That combination is necessary because foreign and domestic residents can face different changes in consumer prices when some outputs are not traded internationally.

Excess burden is the excess of the total burden over the real value of corporate tax revenue:

$$(13) \quad R_C = [\tau_c \cdot (1 + \hat{r}) \cdot (1 + \hat{K}_C^d) \cdot \sum_{i=1}^3 q_i \theta_{Ki}] / (1 + \hat{P}^d)$$

¹⁶ The term "real" is used here merely to represent the adjustment for changes in relative prices.

where q_i is the initial value added by production in sector i and the summed term equals the initial domestic corporate capital stock, all expressed as a share of the total value of domestic output. The real value of corporate revenue equals the real value of government purchases of domestic consumer goods that can be financed by the tax and redistributed to domestic residents.¹⁷

V. A General Replacement Tax on the Domestic Use of Capital

This section examines the effects of a general replacement tax on the income from capital in all domestic sectors. The general tax rate is chosen so that it will finance the same real government expenditures on consumer goods as the corporate tax it replaces.¹⁸

A comparison between those taxes provides a way to isolate the effects that the corporate income tax has on the domestic and international allocations of capital. In a closed economy, the corporate income tax affects efficiency and incidence only through its effects on the allocation of inputs between the corporate and noncorporate sectors. In an open economy, the domestic corporate income tax affects efficiency and incidence through its effect on the allocation of capital both between the domestic corporate and noncorporate sectors and between the domestic and foreign economies. In contrast, the general tax affects only the international allocation of capital. Thus, a comparison between the effects of the corporate tax and the general tax provides a way to separate the effects the corporate tax has because it is imposed only on

¹⁷ Revenue is thus measured in units of a bundle of domestic consumer goods rather than in terms of the numeraire good produced in sector one. Thus, revenue and burden are measured in the same units. Excess burden is then simply any excess of total burden over the value of the lump-sum government distributions financed by the tax.

¹⁸ Both taxes are referred to as taxes “at source” because they are imposed on capital income based on where the capital is used.

some domestic sectors from the effects it has because it is not imposed on the use of capital abroad.¹⁹

Under the general tax, the domestic wage rate falls by less than it does under the corporate income tax because the required replacement value of the general tax rate, τ_g , can be lower than the corresponding corporate tax rate; the general tax is imposed on a broader base. As under the corporate income tax, the wage rate is determined in sector one: The domestic wage rate is determined in the same way as in Equation (2a), but the percentage change in the sector one cost of capital under the corporate tax is replaced by its percentage change under the general tax, $\hat{r}_g + (1 + \hat{r}_g)\tau_g$.

The percentage change in the equilibrium (tax-exclusive) return to capital, which is now the cost of capital only to foreign producers, is given by:²⁰

$$(14) \quad \hat{r}_g = -\tau_g \cdot \frac{K^d}{K + K^d \tau_g}$$

Equation (14) is similar to (4), but the corporate tax rate is replaced by the general tax rate, and the term for the noncorporate capital stock does not enter the equation because all domestic sectors are subject to the general tax. When the general tax rate is extremely small, the second term in the denominator of (14) disappears so that worldwide capital income is reduced exactly by an amount equal to the revenue collected by the tax. As in Bradford (1978), capital

¹⁹ The general tax also represents a corporate integration policy that imposes a single tax rate on the income from all domestic capital investment regardless of the sector in which that capital is invested.

²⁰ Equation (14) is derived under the assumption that the domestic and foreign aggregate partial input substitution elasticities equal each other. For the general tax, the aggregate changes in capital are given by modified versions of (3), where (3b) is ignored and the aggregate domestic capital stock and change in the domestic cost of capital under the general tax are substituted into (3a). Equation (14) is derived by also noting that aggregate country labor supplies do not change and that the world capital supply is fixed.

owners worldwide bear exactly 100 percent of a very small tax on the income from capital used by domestic producers. However, as shown in the numerical application below, the worldwide burden is not divided exactly in proportion to the domestic and foreign ownership shares of world capital, because the tax can have different effects on the prices of domestic and foreign consumer goods, and capital owners must consume where they live.

The effect that the general tax on capital income at source has on output prices follows the same economic reasoning as the analysis of the corporate income tax, except that the price equations include the percentage change in the tax-inclusive cost of capital for all domestic sectors rather than just in the corporate sectors.

The real value of tax revenue under the general tax is given by

$$(15) \quad R_g = [\tau_g \cdot (1 + \hat{r}_g) \cdot (1 + \hat{K}_g^d) \cdot \theta_K] / (1 + \hat{P}_g^d)$$

where $\hat{K}_g^d = \sigma \cdot [\hat{w}^d - \hat{r}_g - (1 + \hat{r}_g)\tau_g]$, and θ_K is the initial domestic capital stock, expressed as a share of the value of output. The tax rate for the general tax is chosen to equate real revenues and, thus, the lump-sum redistributions under the general tax and the corporate tax.

VI. Personal Taxes on Domestic Residents

Personal taxes on domestic residents also provide useful policy alternatives against which to evaluate the international effects of the corporate income tax and general tax. Such personal taxes are nondistortionary under the assumptions of the model used in this study, because the personal supplies of labor and capital are fixed and domestic residents cannot move abroad to escape taxation. As a result, a personal tax on labor income is borne entirely by labor; a personal

tax on the worldwide income of the domestic owners of capital is borne entirely by those owners; and a uniform tax on the personal income or consumption of domestic residents is borne by those residents in proportion to their initial shares of domestic personal income.

VII. A Numerical Application

The model can be applied based on very few assumptions about the economy. Share assumptions (Table 1) apply for the United States and are taken from Gravelle and Smetters (2006).²¹ The capital intensities of sectors one and two are initially equated for simplicity. When those capital intensities are equal, the incidence results are the same as if the first two sectors are combined into one sector for which the foreign and domestic outputs are perfect substitutes. In other words, the fact that sector two produces foreign and domestic outputs that are not perfect substitutes does not affect the incidence results when the first two sectors have the same capital intensities. A later part of the application examines how incidence changes when those capital intensities are different. The domestic economy accounts for 30 percent of world output. In addition, domestic residents are assumed to own 30 percent of world output, so the country is neither a net international lender nor a net international borrower. That assumption is also relaxed later in this study. Consistent with Mutti and Grubert (1985), the partial elasticity of input demand substitution between capital and labor is initially set equal to 0.6.²²

It is not obvious how to choose the right value for the (tax-exclusive) corporate tax rate because the actual U.S. income tax system is considerably more complex than in the model.

After accounting for personal and business income taxes, depreciation rules, business finance,

²¹ The appendix compares the results under alternative share assumptions consistent with Harberger (1995).

²² That value is based on estimates in Hamermesh and Grant (1979). The results of the application in the current study are not very sensitive to a change in that value to 1.0.

and other factors, the Congressional Budget Office (2005b) finds that the U.S. corporate tax causes the cost of capital in the U.S. corporate sectors to be 6.25 percent higher than the cost of capital in the noncorporate sectors. That is the tax rate used in this application. Alternatively, as a benchmark, the model's predictions are calculated when the tax rate is infinitesimally small, which has the advantage that those predictions depend on neither the actual U.S. tax rate nor the input substitution elasticity, but can still be used to characterize the incidence effects of a small change in the corporate income tax.

Economic Responses to the Corporate Income Tax

The model predicts a variety of economic responses to the introduction of the corporate tax in a new long-run equilibrium (Table 2). In response to an increase in the domestic corporate cost of capital, the capital stocks fall in the domestic corporate sectors and rise in the domestic noncorporate sectors and in the foreign country. The domestic corporate capital stock falls by almost 4 percent. The aggregate domestic capital stock falls by 2 percent, which implies that the arc elasticity of the domestic capital stock with respect to the 6.25 percent corporate tax is 0.32. For each one percent by which the tax initially increases the corporate cost of capital, the domestic capital stock falls by 0.32 percent.²³

Those investment responses drive down the cost of capital by 1.2 percent for the untaxed producers in the domestic noncorporate sectors and the foreign sectors. As a result, the cost of capital for domestic corporate producers increases by only 5.0 percent in response to the 6.25 percent corporate tax.

²³ Even though capital is perfectly mobile, only a finite percentage of the domestic capital stock is reallocated abroad in response to the tax, because a reduction in the capital stock increases the marginal product of capital in the domestic corporate sectors.

The reallocation of capital also affects wages. Because there is less domestic capital, and labor cannot emigrate, the domestic wage rate falls by 1.1 percent, driven by competition in sector one (Equations 1 and 2). The domestic wage rate has to fall by that amount in order to offset the increased corporate cost of capital. Similarly, the foreign wage increases by 0.25 percent because the larger foreign capital stock improves the productivity of foreign labor. The foreign wage rate increases by just enough for the resulting increase in labor costs to fully offset the decrease in capital costs for sector one of the foreign economy.

Both domestic and foreign land rents increase. The domestic land rent rises because the costs of labor and capital both decline for sector four (agriculture), so that land becomes more productive. Foreign land rent rises because sector four is more capital-intensive than sector one, so the decline of the foreign cost of capital more than fully offsets the increased cost of labor to sector four of the foreign economy.

Overall, consumer prices fall slightly in both countries. Output prices do not change in the first two sectors (mostly manufacturing), because sector one produces the numeraire and sector two has the same capital intensity as sector one. Thus, any wage change that exactly offsets the increased cost of capital in sector one will also exactly offset the increased cost of capital in sector two. Sector three, the other corporate sector (utilities and transportation), is more capital-intensive than sector one. As a result, the price of the domestic sector three output increases because the rise in the corporate cost of capital more than fully offsets the decrease in labor costs. Similarly, the price of sector three output in the foreign economy falls slightly because the decreased foreign cost of capital over-compensates for the increased foreign labor cost. The price of output in sector four (agriculture) does not change, by assumption. For

domestic output of sector five (housing and retail services), the domestic price declines because both capital and labor become cheaper for that sector. The foreign price of sector five output also declines because sector five is more capital-intensive than sector one, so the effect of a decrease in the foreign cost of capital dominates the increase in the foreign wage rate.

Real private incomes, before government transfers, change for both domestic and foreign residents. Those changes are the tax burdens. For domestic residents, labor and capital incomes each fall by about 1 percent. A small overall decrease in the domestic prices of consumer goods only slightly offsets the fall in domestic wages and the decrease in the domestic capital owners' return to their share of the world capital stock. In contrast, real income paid to domestic landowners increases because land rents increase and consumer prices fall. When combined, the aggregate real domestic private income falls by 0.978 percent before government transfers. Because the real value of revenue from the tax (the real value of government purchases of consumer goods financed by the tax) equals only 0.944 percent of the initial domestic income, the domestic real national income is reduced by about .035 percent (not shown in Table 2). That national loss equals about 3.7 percent of the revenue from the tax ($100 * 0.035 / 0.944$).²⁴

Foreign labor benefits from both an increase in the foreign wage rate and an overall decrease in foreign consumer prices. Foreign capital owners lose from a reduced return to their capital. That loss is offset somewhat by a reduced foreign cost of consumer goods. Foreign land

²⁴ That is the worldwide deadweight loss, or excess burden from the tax. The deadweight loss is relatively small because the tax is small and there are no other pre-existing distortions. Because this study is about the distribution of the burden, it would be sufficient to assume that the tax rate is infinitesimal, as is done in a later section, below. However, using a small finite tax rate allows the numerical application to illustrate the potential size and nature of some of the important economic effects of the tax. The value obtained for excess burden in the example should therefore not be taken seriously as an estimate of the overall excess burden of the corporate income tax.

owners benefit slightly from an increase in foreign land rents and a decrease in the cost of foreign consumer goods.

Overall, the gains of foreign workers and landowners are exactly offset by the losses of foreign capital owners so that none of the net burden of the tax is exported under the basic assumptions. In effect, the domestic corporate tax shifts the foreign distribution of income toward labor and landowners and away from foreign capital owners. Under alternative assumptions, as examined later in this application, the tax can also shift either a net burden or a net benefit to foreign residents.

Burdens of the Corporate Income Tax

Under the basic assumptions, domestic labor and capital owners bear the corporate tax roughly in proportion to their initial shares of income. Expressed as shares of real tax revenue (Table 3), the burdens imposed on domestic workers and capital owners are just above their initial shares of domestic income. Domestic labor bears 73.7 percent of the corporate tax burden and receives about 70 percent of income in the no-tax equilibrium. Domestic capital owners bear 32.5 percent of the corporate tax burden and receive about 29 percent of income in the no-tax equilibrium. Domestic landowners benefit by 2.5 percent of the revenue.

The domestic corporate income tax shifts the foreign distribution of income away from capital owners toward labor and, slightly, toward landowners. Foreign labor's benefit is about equal to domestic labor's loss, but that benefit to foreign labor is almost exactly offset by the loss to foreign capital owners.

When measured on an aggregate worldwide basis, labor bears very little (2.4 percent of the revenue) of the burden from the corporate income tax. In contrast, capital owners worldwide bear slightly more than 100 percent of the burden (104.7 percent of the revenue), almost in proportion to the domestic and foreign ownership shares of capital.²⁵

Those worldwide implications are similar to the central predictions of the closed-economy analysis of Harberger (1962), in which all capital owners bear the full burden of the U.S. corporate tax and labor escapes the burden. The essential difference from the closed economy is that both labor and capital can be reallocated freely between sectors in the closed economy, but only capital can be reallocated between countries in the open economy. Worldwide, capital owners still do not escape the tax in the open economy, but domestic labor bears a burden because domestic workers cannot emigrate to take advantage of an increased foreign wage rate. Domestic capital owners can escape part of the burden because, unlike workers, they do not have to live where their capital is used. If labor could move freely internationally, the domestic and foreign wages would be equal. In that case, analysis of the open-economy incidence would be just like analysis of the closed-economy incidence. For such an open economy, all foreign sectors would simply be part of the noncorporate sectors. Otherwise, the closed-economy analysis could be applied directly.

²⁵ Not shown in Table 3, worldwide capital income is reduced by 119.3 percent of the tax revenue. However, a decline in domestic and foreign consumer prices offsets part of that capital income reduction so that the burden for capital owners worldwide equals 104.7 percent of the tax revenue.

Economic Responses to the General Replacement Tax

The economic changes under the general tax are different from the changes under the corporate tax (Table 2) because the general tax rate is lower than the corporate tax rate and the general tax is imposed on all domestic sectors rather than just the corporate sectors.

Compared to the corporate tax, the foreign cost of capital does not decline by as much under the general tax because less of the world capital stock is reallocated abroad in response to the general tax. The domestic cost of capital increases in all sectors, but by less than half as much as in the domestic corporate sectors under the corporate tax. As a result, the domestic wage rate does not have to decrease by as much as under the corporate income tax, because less capital has to be reallocated away from sector one in order for the resulting decrease in labor costs to fully offset the increase in capital costs. The foreign wage rate increases by slightly less than it does under the corporate tax, also because less capital is reallocated abroad. The domestic land rent declines under the general tax because the prices of labor and capital change by the same amounts in every domestic sector. The domestic land rent falls because sector four is more capital-intensive than sector one. The foreign land rent increases by slightly less than it does under the corporate tax.

Domestic consumer prices actually increase under the general tax. The price of sector three output (utilities and transportation) increases by less than it does under the corporate tax. But, in contrast to the corporate tax, the price of sector five output (housing and retail services) increases because that sector's cost of capital increases under the general tax, and sector five production is more capital-intensive than production in sector one. In contrast, foreign consumer prices decline by slightly less overall than under the corporate tax.

Those economic differences from the corporate tax imply that, if the general tax were to replace the corporate tax, capital would be reallocated to the domestic corporate sectors and away from the foreign country and the domestic noncorporate sectors. The aggregate domestic capital stock would increase, causing domestic wages to also increase. The foreign capital stock would decrease, causing the foreign wage rate to fall and the foreign cost of capital to increase. Domestic and foreign land rents would fall, especially the domestic rents. Domestic consumer prices would increase and foreign consumer prices would increase very slightly.

Replacement of the corporate tax by the general tax would also cause real private incomes to change. Domestic labor would gain because the domestic wage increase would be more than large enough to offset the increase in domestic consumer prices. Foreign labor would lose because foreign wages would fall while foreign consumer prices would rise. Because domestic consumer prices would increase, domestic capital owners would be worse off than under the corporate tax, even though their capital would be used more efficiently worldwide than under the corporate tax. But foreign capital owners would be better off because the foreign consumer prices would not increase by enough to offset their benefit from the more efficient use of capital. Landowners, especially domestic landowners, would lose from the replacement tax. As under the corporate tax, aggregate real foreign income would not change under the replacement tax. Domestic national income would increase slightly because the general tax at source would achieve a more efficient domestic allocation of capital than the corporate tax.

Burdens of the General Replacement Tax

If the corporate tax were replaced by the general tax, the excess burden would be reduced (Table 3). Under the general tax, the excess burden would decline by almost half from 3.7 percent to just 2.0 percent of revenue because capital would be allocated more efficiently. Domestic capital would then provide the same marginal return in all sectors. Some capital would also be reallocated from abroad, so that the difference between the domestic and foreign pre-tax returns would be smaller than it is under the corporate tax. All of the benefit of that increase in efficiency would go to domestic residents, as an increase in real domestic national income equal to 1.7 percent of the tax revenue. There would be no change in the real foreign national income.

Replacement by the general tax would also change the distribution of tax burdens (Table 3). It would transfer roughly 13 percent of the burden away from domestic labor and toward domestic capital owners and landowners. It would also transfer about 10 percent of the burden away from foreign capital owners toward foreign labor and landowners.

Differential Burdens of Other Taxes

The personal taxes also provide useful comparisons (Table 3). Under the assumptions of the model used in this study, none of those taxes distort behavior because each is imposed on domestic residents who can not move abroad to escape the tax, nor can they change their labor supplies or savings behavior. Replacement of the corporate income tax by any of those taxes would therefore eliminate the excess burden and exactly reverse the distributional effects that the corporate tax has on foreign residents. Foreign labor and landowners would be worse off by an amount that is transferred, exactly, to foreign capital owners.

Domestic labor would bear all of the burden of the wage tax, so their burden would increase by about 26 percent of the revenue under the replacement tax. The burden shares of domestic and foreign capital owners would decrease and the burden shares of foreign labor would increase by amounts equal to their burden shares of the corporate tax. On a worldwide basis, a domestic wage replacement tax would shift roughly the entire burden from capital owners to domestic labor.

Domestic owners of capital would bear the full burden of a domestic tax on their worldwide capital income. If that tax was used to replace the corporate tax, their share of the tax burden would increase by 67.5 percent of the revenue. The burden shares for domestic labor and land owners would change by amounts that exactly offset their shares of the corporate income tax burden.

That worldwide tax on domestic capital owners achieves Capital Export Neutrality (CEN) because it is imposed on the residents' capital income regardless of where that capital is used in production. The U.S. and most foreign corporate income taxes violate CEN because they are effectively imposed on the domestic use of capital, regardless of where that capital is owned.²⁶ Although replacement by the tax on worldwide capital income of domestic residents would improve worldwide efficiency in the allocation of capital, the worldwide efficiency gain equal to 3.7 percent of the revenue would be realized fully as an increase in the aggregate domestic national welfare. Compared to that small efficiency gain, the domestic and foreign income redistribution effects of switching to the tax that achieves CEN would be very large. On a

²⁶ That is not how the U.S. corporate tax is described legally, but how it works in practice as a result of the combined effects of all international tax rules and corporate behavior (see Grubert, 2004).

worldwide basis, however, both labor and capital owners would be only slightly better off.

Landowners would be slightly worse off.

If the corporate tax were replaced by a uniform tax on the income or consumption of domestic residents, domestic labor and capital owners would both gain slightly and landowners would lose.²⁷ Those changes would be small because the domestic burden shares of the corporate income tax are approximately equal to the domestic residents' shares of income or consumption, and hence to the shares of burden under a personal income or consumption tax. On a worldwide basis, such a replacement tax would cause a substantial transfer of income from labor to capital owners, almost entirely due to its effects on foreign residents.

Infinitesimal Corporate Tax Rate

The tax incidence is not affected much by assumptions about the level of the corporate tax rate and the size of the input substitution elasticity. That lack of sensitivity can be seen by analyzing the effects of an infinitesimal tax rate (Table 4), which would approximate the effects of a very small increase in the corporate tax rate. The burden shares shown in Table 4 are almost the same as the burden shares shown in Table 3. The main difference is that the excess burden disappears when the tax rate is very small. In that sense, Table 4 shows the pure incidence effects of the corporate income tax.

²⁷ The differential incidence of that replacement tax also measures the balanced-budget incidence of eliminating the corporate tax if the government were to offset the loss of corporate tax revenue by reducing its spending – its distributionally neutral lump-sum transfers.

Aggregate International Spillover Effects

Under the assumptions used so far, the domestic corporate income tax distorts the allocation of capital and changes the domestic and foreign intranational distributions of income. But the tax does not affect the aggregate international distribution of incomes. Not even the excess burden is exported in the aggregate, even though the tax causes capital to be allocated inefficiently on a worldwide basis. The tax burden is not exported or imported in the aggregate because the initial domestic and foreign per capita wealth endowments are assumed to be equal, and because the corporate tax has no tariff-like effects when the first two sectors have the same capital intensities.

The corporate income tax can, however, affect the aggregate international distribution of income under alternative assumptions, but the international transfer can go in either direction. The aggregate tax burden can be exported or imported, and the effect on the foreign distribution of income can be more or less intensified.

The simplest international transfer can arise when the domestic country is a net international lender or net international borrower. One of those situations would arise when the two countries had different initial per capita wealth endowments. First, suppose that the domestic country is a net international lender. While the domestic capital stock equals 30 percent of the world capital stock (the base case), suppose that domestic residents own 35 percent of world capital. Now, the corporate tax has the same effects on production and prices as in the base case, but domestic capital owners bear a larger share of the burden (Table 5). Compared to the base case, the domestic capital owners' share of the burden increases and the foreign capital owners' share falls, each by slightly more than 5 percent. Those changes are slightly greater than

5 percent because, although consumer prices fall in each country, domestic consumer prices fall by less than foreign consumer prices (Table 2). That difference between domestic and foreign consumer price changes, compared to the base case, also causes the excess burden of the tax to increase slightly from 3.7 percent to 4.0 percent of tax revenue. The aggregate domestic real national income falls by an amount equal to 9.1 percent of the tax revenue. Compared to the base case, the aggregate domestic excess burden increases from 3.7 percent to 9.1 percent of tax revenue. Foreign real national income increases by 5.2 percent of the revenue, so foreign residents receive a net benefit from the tax.

Thus, aggregate foreign welfare is improved by the domestic corporate tax when the domestic country is a net international lender. Aggregate domestic welfare falls. That international transfer occurs because foreign labor and landowners benefit from the same increased stock of foreign capital as when the two countries are equally wealthy, but the domestic capital owners now bear a greater share of the burden because they own a larger share of the world capital stock. The foreign capital owners bear a smaller share of the burden.

The aggregate international burden is shifted in the opposite direction if the domestic country is a net international borrower. Suppose that the domestic residents own only 25 percent of the world capital stock. In that case (Table 5), some of the domestic tax burden is exported and the worldwide excess burden is slightly lower than in the base case, because foreign consumer prices are lower than domestic consumer prices in the new equilibrium.

In summary, an aggregate benefit is exported if the domestic country is a net international lender. An aggregate burden is exported if the domestic country is a net international borrower.

The domestic corporate income tax can also affect the international distribution of income if the capital intensities are not equal for production within sectors one and two.²⁸ Those international spillover effects can also go either way depending on whether sector two is more or less capital-intensive than sector one. However, the effects of altering the relative capital intensities are more complicated than the effects of changing the shares of capital ownership. Those complications arise because both national and subnational distributions of the tax burdens are modified by a change in the assumptions about relative capital intensities.

First, suppose that sector two is more capital-intensive than sector one. Suppose that capital's initial share equals 20 percent of the value added in sector two, rather than 18 percent (as in Table 1, the base case). In addition, suppose that sector one accounts for 25 percent of the value added by the first two sectors combined, and that the sector one capital share is only 12 percent rather than 18 percent (as in Table 1, the base case). Under those assumptions, the aggregate capital intensity and output shares of sectors one and two combined are the same as in the base case. All other shares are also unchanged.

Under those alternative assumptions, domestic labor bears a smaller share of the burden (Table 5) than in the base case. Domestic labor bears 59 percent rather than 73.7 percent of the burden. Domestic labor's share of the burden is smaller because the domestic wage rate falls by less than in the base case and the rate of return paid to capital owners falls by slightly more than in the base case (Table 6). The domestic wage rate falls by less mostly because sector one production is more labor-intensive than it is in the base case. As described by Equation (2a), when sector one is more labor-intensive, the wage rate does not have to fall by as much to fully

²⁸ Recall that those sectors are the corporate sectors that produce internationally tradeable outputs. The foreign and domestic outputs of sector one are perfect substitutes and the foreign and domestic outputs of sector two are imperfect substitutes.

offset the increased cost of capital in that sector. In addition, the domestic corporate cost of capital increases by slightly less than in the base case because sector one is now more labor-intensive.²⁹

Also under those alternative assumptions, compared with the base case, domestic owners of capital bear a larger share of the burden imposed on worldwide capital owners (Table 5) because the domestic owners of capital must pay higher consumer prices than before, whereas foreign capital owners pay slightly less for consumer goods than in the base case. Domestic consumer prices now rise by 0.11 percent rather than falling by 0.11 percent, as in the base case (Table 6). In contrast, foreign consumer prices decline by slightly more (-0.18 percent) than in the base case (-0.16 percent).

Overall, when sector two is more capital-intensive than sector one, some of the aggregate burden of the tax is exported (Table 5). Foreign residents bear an aggregate burden equal to 8.7 percent of the revenue. Domestic residents bear an aggregate burden equal to just 94.9 percent of the revenue. The effect that the domestic corporate tax has on the foreign subnational distribution of income is also less pronounced than in the base case.

Alternatively, when sector two is less capital-intensive than sector one, the aggregate international effect is reversed (Table 5). Domestic labor bears a larger share of the burden (90.6 percent) and foreign labor receives a larger benefit (87.8 percent) than in the base case. Compared to the base case, the domestic capital owner's burden is smaller (26.7 percent) and foreign capital owner's burden is larger (78.2 percent). Overall, domestic residents bear 113.9 percent of the domestic corporate tax. Foreign residents benefit by 10.1 percent of the revenue.

²⁹ The importance of labor intensity in sector one is shown by equation (4) and is explained in the discussion that follows that equation.

The effect of the corporate tax on the international distribution of incomes can be understood, in part, by comparing it to the effect of a domestic export tax or subsidy placed on the domestic output of sector two. When sector two is more capital-intensive than sector one, the corporate tax increases the domestic price of output from that sector and decreases the price of output from the corresponding foreign sector. That improvement in the international terms of trade creates a benefit for the domestic residents at the expense of foreign residents. In that way, it has an effect that is similar to an ad valorem tariff placed on the domestic exports from that sector. When sector two is less capital-intensive than sector one, the effect is reversed. The international terms of trade are worsened for domestic residents. Foreign residents are made better off at the expense of domestic residents, similarly to the effect of an domestic export subsidy for the output of sector two. The similarity to either an export tariff or an export subsidy is limited, however, because the corporate tax also affects the allocation of capital and of input and output prices in many other ways that differ from the effects of an export tax or subsidy.³⁰

Relative Size of the Domestic Economy

A change in the assumption about the size of the domestic economy relative to the world economy affects both the incidence and efficiency of a domestic corporate tax. To explore those effects, the tax burden shares can be measured on either an aggregate basis or a per capita basis. Aggregate burdens measure the total effects of the tax on domestic and foreign residents, expressed as shares of total domestic revenue. Per capita burdens are expressed, instead, as per capita shares of the domestic per capita revenue. Domestic burden shares have the same values

³⁰ Melvin (1982) discusses the tariff-like effects of the corporate income tax in a much simpler two-sector trade model with no international capital mobility. That simpler model makes it easier to understand the similarity to the effects of a tariff.

either way, but foreign per capita shares account for the fact that when domestic output is a smaller share of world output, the domestic revenue is smaller and the foreign burden is divided among a larger number of foreign individuals. For example, when the domestic economy is only 1 percent of the world economy, foreign labor's total benefit is about the same as domestic labor's total loss (Table 7), but foreign labor's per capita gain is less than 1 percent of domestic labor's per capita loss (Table 8).³¹ Changes in a very small country cannot have much of an effect on each person in the rest of the world.

Domestic labor bears more than 100 percent of the burden when the domestic economy produces less than 5 percent of world output (Table 8). For such a small economy, both domestic labor and domestic capital owners would be better off under a domestic tax on wages. Whether that small country chooses to impose a corporate income tax has only a small effect on foreign individuals.

When burden is measured on a per capita basis, the shares borne by domestic and foreign labor and capital correlate closely with the relative size of the domestic economy (Table 8). The per capita burdens imposed on individual capital owners, domestic or foreign, are roughly equal to the domestic economy's share of world output.³² Domestic labor's per capita share of the burden is slightly higher than the foreign economy's share of world output. Foreign labor's per capita share of the burden is slightly above the domestic economy's share of world output.

The excess burden, measured as a share of revenue, is largest when the domestic economy is smallest. That excess arises because the corporate tax causes capital to be allocated

³¹ Computations for Tables 7 and 8 use the same assumptions as the base case for the United States. It is assumed that the populations are proportional to the sizes of the economies.

³² Domestic capital owners bear a slightly higher burden than foreign capital owners, because domestic consumer prices increase by more than foreign consumer prices.

inefficiently away from the domestic corporate sector and out of the domestic economy. Both sources of inefficiency become smaller relative to domestic revenue as the domestic economy is assumed to be relatively larger (not shown in Table 8). In the limit, when the domestic economy is the whole world, only the domestic misallocation of capital remains. The excess burden equals 4.8 percent of revenue when the domestic economy is only 1 percent of the world, but only 1.2 percent of revenue when the domestic economy is the whole world. Of course, 1.2 percent of revenue collected if every country imposed the same corporate tax would be much larger than 4.8 percent of revenue collected by a country that makes up only 1 percent of the world economy.

Capital Mobility

Throughout this study, capital is assumed to be perfectly mobile in the sense that the marginal return to investment, excluding producer-level taxes, is the same throughout the world. The question about the true degree of international capital mobility is unresolved, especially since the work of Feldstein and Horioka (1980), who discovered a high and very robust correlation between national investment and national savings, which suggested that capital was not very mobile. However, more recent work suggests that the Feldstein-Horioka result is not as robust as once believed.³³ Moreover, it is not clear exactly what the Feldstein and Horioka implies about the degree of capital mobility.³⁴ However, given that a significant level of uncertainty and disagreement among economists remains, it is important to consider the possible implications of imperfect international capital mobility.

³³ See Coakley, Kulasi, and Smith (1998) and Coakley, Fuertes, and Spagnolo (2004).

³⁴ See Obstfeld and Rogoff (1996), pp. 161-164.

It is possible, as in Mutti and Grubert (1985) and Gravelle and Smetters (2006), to model international capital mobility by assuming that individual investors do not substitute perfectly between foreign and domestic investments. However, that strategy complicates the analysis considerably and is not necessarily the best way to characterize the behavior of the marginal investor in a long-run equilibrium. An alternative and much simpler approach to changing the degree of capital mobility is to imagine that the rest of the world is smaller, in which case there would be fewer opportunities for capital to be reallocated abroad. In that case, any international reallocation of capital away from the domestic economy drives down the marginal return to investment at a higher rate per unit of reallocated capital. That phenomenon causes less capital to be reallocated abroad in response to the domestic corporate tax, in a way that is similar to the effect of assuming that domestic and foreign investments are not perfect substitutes for investors. In effect, the marginal investor is still assumed to be indifferent between domestic and foreign investments that pay the same rate of return, but only for investments in some of the countries – perhaps between the highly industrialized countries. For other countries, they are completely unwilling to substitute between domestic and foreign investments at any relative rates of return.

As capital mobility is reduced in that way, domestic labor's share of the corporate burden becomes smaller and domestic capital's share of the burden becomes larger. For example, when the domestic economy is increased from 30 percent of the world economy to 70 percent of the world economy, domestic labor's share falls from 73.7 percent to 32.5 percent (Table 8). Domestic capital's share of the burden increases from 32.5 percent to 72.7 percent.³⁵ Because

³⁵ In the limit, domestic capital owners bear the full burden of the corporate tax when the domestic economy is the entire world, the tax rate is infinitesimally small (no excess burden), and the gain to land is distributed to labor and capital owners in proportion to their initial income shares. That result coincides with the central case in Harberger (1962) for the closed economy.

capital is less mobile when the domestic economy provides 70 percent of the world's investment opportunities to domestic capital owners, the arc elasticity of the domestic capital stock with respect to the corporate tax falls from -0.32 to -0.13.

The degree of long-run international capital mobility is still an unresolved question. Clearly, the answer to that question is crucial for understanding the long-run incidence of the corporate income tax in an open economy.

Tax Competition

Although many countries impose corporate income taxes, the corporate tax rates have decreased over the past 25 years.³⁶ Country competition caused by international spillover effects might help explain why countries have different corporate tax rates, but it is not clear how those spillovers would explain the observed downward trend in corporate tax rates.

The possibility of tariff-like competition seems to lead in the wrong direction. If the corporate income tax has tariff-like effects that allow countries to export some of their corporate tax burdens, the corporate tax can serve as a substitute for tariff competition when tariffs are limited by international trade agreements. But tariff competition is unlikely to explain the observed downward trends in corporate tax rates. To the extent that the corporate income tax acts as a tariff substitute, tariff competition would motivate countries to increase their corporate tax rates as trade agreements become more binding.

Spillovers that result from a country's net international capital position also do not obviously explain the downward trend in corporate tax rates. On an aggregate basis, residents of

³⁶ See Congressional Budget Office (2005a) and Devereux, Griffith, and Klemm (2002).

a country that is a net international lender would benefit from a reduction in their domestic corporate tax rate (Table 5). By that same aggregate measure, however, residents of a country that is a net international borrower would benefit from an increase in their own corporate tax rate. Countries that have gradually reduced their corporate tax rates include both net international lenders and net international borrowers, so those spillovers probably do not explain the downward trends.

International spillovers that affect the subnational distributions of income might explain part of the observed trend, but even the role of those spillovers is not obvious. If, for some reason, other countries reduce their corporate tax rates first, then a country might reduce its own corporate tax rate to protect its domestic workers from the potential outflow of capital. However, if that is a country's motivation for reducing its corporate tax rate, then it is not clear why the country would wait for other countries to reduce their taxes first. Even if all countries impose a corporate income tax, any one country could improve the welfare of its domestic workers by reducing its corporate tax.

Instead of tax competition, it is possible that international capital mobility has increased over the last 25 or 30 years, and that countries have reduced their corporate tax rates in response to that common trend. Without capital mobility, the corporate income tax is more likely to be borne by the domestic owners of capital. When capital is mobile, a corporate income tax is borne more heavily by domestic labor, especially for a tax imposed by the smallest countries. Some of those smallest countries have reduced their corporate taxes by the most over the past 25 years.³⁷

³⁷ See Congressional Budget Office (2005a).

Perhaps, out of concern for their domestic labor, countries have responded to the changing distributional consequences of corporate tax as capital mobility has increased.

Although the model does not explain the observed trends in any obvious manner, the model can be used to explore how those trends might affect the distribution of tax burdens. The potential effects can be observed based on the relation between country size and the per capita burden shares (Table 8). To simplify the analysis, rather than trying to analyze gradual changes in corporate tax rates, suppose that 90 percent of the world output is produced in countries that impose a corporate income tax, and that real tax havens produce the other 10 percent. Initially, on an average per capita basis, workers in the countries that are not tax havens bear only 12.3 percent of the corporate tax burden compared to an equilibrium in which none of those countries imposes a corporate income tax. Workers in the tax-haven countries receive an average per capita benefit equal to 89.7 percent of the per capita revenue.

Although the average labor share of the burden is small in the countries that are not tax havens, that burden can be much larger when it is measured at the margin for a country deciding whether to impose a corporate income tax. For a small country that is not a tax haven, domestic labor's benefit from eliminating its own corporate tax would equal 102 percent of its domestic revenue from the tax: the difference between the average burden of 12.3 percent within the countries that are not tax havens and the average per capita benefit of 89.7 percent within the tax-haven countries. From a distributional perspective, it makes little difference whether that small country is the only country to have a corporate income tax or is just one among many countries that tax corporate income, as long as countries can choose their tax policies independently. That is also true for larger countries. For example, in a country that is not a tax haven and that

produces 20 percent of world output, domestic labor's burden at the margin would equal 82.6 percent (12.3 percent +70.3 percent) of the domestic corporate tax revenue.

If countries move into the tax-haven group, labor's average per capita benefit falls for residents of the tax-haven countries and rises for residents of the other countries. For example, when the tax-haven group grows from 10 percent to 30 percent of world production, labor's average per capita benefit falls from 89.7 percent to 70.3 percent for residents of the tax havens. Labor's average per capita burden rises from 12.3 percent to 32.5 percent for residents of the countries that are not tax havens.

Although the model does not obviously provide a theory of tax competition that would explain the observed trends in corporate tax rates over the past 25 or 30 years, the analysis does suggest that those trends can shift the burdens of the corporate income tax in an open economy. Such shifts might help explain country motivations that underlie the observed international trends in corporate tax policies.

VIII. Conclusions

The analysis shows how the domestic owners of capital can escape most of the corporate income tax burden when capital is reallocated abroad in response to the tax. But, as in Bradford (1978), capital owners worldwide do not escape the tax. Reallocation of capital abroad drives down the personal return to investment so that capital owners worldwide bear approximately the full burden of the domestic corporate income tax. Foreign workers benefit because an increased foreign stock of capital raises their productivity and their wages. Domestic workers lose because their productivity falls and they cannot emigrate to take advantage of higher foreign wages.

Under basic assumptions of the numerical application, the outcome is also similar to the implications of the simpler model of Bradford in the sense that the full worldwide burden falls on domestic owners of productive inputs.

Burdens are measured by substituting factor shares and output shares that are reasonable for the U.S. economy. Given those values, when capital is perfectly mobile and the tax does not affect the world prices of traded goods, domestic labor bears slightly more than 70 percent of the long run burden of the corporate income tax. The domestic owners of capital bear slightly more than 30 percent of the burden. Domestic landowners receive a small benefit. At the same time, the foreign owners of capital bear slightly more than 70 percent of the burden, but their burden is exactly offset by the benefits received by foreign workers and landowners. When capital is less mobile internationally, domestic labor's burden is lower and domestic capital's burden is higher. Burdens can also be affected by the domestic country's ability to influence the world prices of some traded corporate outputs, but the signs and magnitudes of those changes depend upon the relative capital intensities of production in the corporate sectors that produce internationally tradable goods.

That distribution of burdens is quite different from the predictions of Harberger's (1962) closed-economy analysis, which implies that domestic capital owners bear the entire U.S. corporate income tax in the long run. Those closed-economy predictions still apply to the world as a whole. But in an open economy, the tax causes income to be redistributed internationally between foreign and domestic owners of capital, and intranationally between the labor and capital owners resident within each country. Foreign owners of capital bear the domestic

corporate income tax roughly in proportion to their ownership of the world capital stock.

Foreign labor benefits by about that same amount.

In addition to its effects on the domestic and foreign subnational distributions of income, a corporate income tax can redistribute the aggregate national incomes between domestic and foreign residents. For example, to the extent that the taxing country is a net international lender, its corporate income tax can transfer national incomes away from domestic residents toward foreign residents. Alternatively, when the taxing country is a net international borrower, the international transfer is reversed: Part of the aggregate tax burden is exported to foreign residents. But only capital owners are affected by the aggregate international transfers that occur when the country is either a net international lender or borrower; labor's burden is unaffected.

Similarly, the corporate income tax can redistribute national incomes in a way that is like an ad valorem tariff on exports, as in Whalley (1980). However, the size and direction of that effect depend upon the relative capital intensities of production for internationally tradable corporate outputs that are imperfect substitutes for their foreign produced counterparts. When that production is more capital-intensive than production of the other tradable corporate outputs, a corporate income tax shifts national income toward domestic residents from abroad. In effect, domestic residents benefit from their own country's ability to exert some market power in international trade by imposing a corporate income tax. As shown in Melvin (1982) and Gravelle and Smetters (2006), domestic labor's share of the tax burden can be lower when the domestic country has such market power. However, if production of the imperfect substitutes is instead less capital-intensive than production of the other tradable corporate outputs, the tariff-

like effects of the corporate income tax are reversed: The tax shifts national incomes toward foreign residents and increases domestic labor's burden.

This study also examines how replacement of the corporate income tax by any of four alternative taxes would affect the distribution of tax burdens:

- Replacement by a general tax on income generated by the use of capital within all domestic sectors – a tax that does not distinguish between corporate and noncorporate investments – shifts about 13 percent of the tax burden away from domestic labor toward domestic capital owners.
- Replacement by a tax on domestic labor income shifts the entire domestic resident capital owners' burden toward domestic labor. That shift increases domestic labor's share of the burden by about 26 percent of the tax revenue.
- Replacement by a tax on the worldwide capital income of domestic residents – a tax that achieves capital export neutrality – shifts the entire amount of domestic labor's burden toward the domestic owners of capital. That shift increases the domestic resident capital owners' share of the burden by about 68 percent of the tax revenue. Worldwide, both labor and capital owners benefit slightly from an increased investment efficiency under that replacement tax, but the largest changes are in the redistribution of tax burdens toward the domestic owners of capital away from domestic labor, and away from foreign owners of capital toward foreign labor.
- Replacement by any of the last three domestic personal taxes would eliminate foreign labor's benefit and the foreign resident capital owners' burden, equal to about 70 percent of the tax revenue.

The model does not provide a theory of international tax competition, but its predictions offer insights into how the tax burdens are redistributed when more than one country imposes a corporate income tax. When more countries impose the tax, the international effects are less pronounced on average within those taxing countries and more pronounced within the other countries, the tax havens. If the tax havens account for only a small share of world production, labor's burden is also small on average for residents of the countries that are not tax havens. But labor's benefit can be large on average for residents of the tax havens. The benefit from reducing the tax can also be large at the margin for workers resident in any small country that is not a tax haven. That marginal benefit equals the difference between labor's burden from residing in a country that is not a tax haven and labor's benefit from residing in a tax haven. When countries are added to the tax-haven group, the average corporate tax burdens within the existing tax-haven countries are shifted toward workers and away from their resident capital owners. As more countries become tax havens, workers living in the countries that are not tax havens acquire an increasing average share of the burden. The average burdens are reduced for capital owners in those countries. For a country at the margin of deciding whether to impose or change the corporate income tax, however, it makes almost no difference to domestic residents whether other countries impose corporate income taxes.

Appendix: Other Studies

Harberger

The model developed in this study is based on Harberger (1995), but the results appear quite different from that study. That earlier study predicted that “labor will bear 2 to 2½ times the full burden of the U.S.” corporate income tax.³⁸ This study predicts that domestic labor would bear about 74 percent of the corporate income tax under share assumptions appropriate for the U.S. economy. The wide gap between those predictions is explained partly by a difference in assumptions about capital intensities and output shares. But most of the difference arises because the burdens are measured differently. The Harberger (1995) conclusion is based only on changes in the sources of income, whereas this study combines the effects on both sources and uses. A recent study by Harberger (2006) concludes that domestic labor bears 96 percent of the burden. That study reaches a conclusion different from Harberger (1995) mainly because the later study combines the effects on both sources and uses in its measure of burden, but also because the later study makes slightly different assumptions about the U.S. economy.

Harberger (1995) does not fully specify the capital intensities and output share assumptions necessary to examine the effects on both sources and uses. However, the capital intensities and output shares can be specified in a way that is consistent with Harberger’s (1995) assumptions: that labor employed in the first two sectors accounts for one-fourth of the domestic labor force; that capital used in the first two sectors accounts for one-half of all capital used in the corporate sectors; and that domestic capital accounts for three-eighths of the world’s capital stock. Otherwise, the parameter values (Table A1) have been completed with share assumptions

³⁸ Harberger (1995), p. 65.

made by Gravelle and Smetters (2006), most critical of which is the assumption that labor receives about 70 percent of the value of total output. Compared to the base case in this study (Table 1), the capital intensity is assumed to be higher in the first two sectors (manufacturing). Also, in contrast to the base case, sector three (utilities) is assumed to be less capital intensive than the first two sectors.³⁹

The Harberger (1995) results can be reproduced for a very small economy when the tax rate is infinitesimal (Table A2). Focusing only on the sources of income, domestic labor bears 200 percent of the burden of the corporate income tax. However, the domestic consumer's benefit equals 95.8 percent of the tax revenue, so when the sources and uses are combined, domestic labor bears only 132.9 percent of the burden – still a very large share. But the sources-side measure of burden has little meaning by itself. As discussed in an earlier section of this study, the sources-side measure is meaningful only if it is combined with the other domestic sources-side burdens as a way of measuring changes in the relative distribution of income paid to different domestic factor owners. Further, the sources-side burden cannot be compared directly to the sources-side burdens of foreign residents because domestic and foreign consumer prices change by different amounts.⁴⁰ The relative real incomes of foreign and domestic residents are therefore functions of those different changes in consumer prices.

When the effects on sources and uses are combined, predictions about burdens of the corporate income tax are not changed substantially by the assumptions in Table A1 (compared

³⁹ Alternatively, the first three sectors can be assumed to have the same relative capital intensities as in Table 1, but the capital intensity of sector five must be much lower for the Harberger (1995) assumptions to be satisfied. Either way, those assumptions do not appear to be reasonable for the U.S. economy. Sector three includes utilities and transportation, both of which are more capital-intensive than the manufacturing in sectors one and two. Sector five includes housing and retail services, for which production is much more capital intensive than manufacturing.

⁴⁰ Under the assumptions in Table A1, the domestic consumer's burden is -95.8 percent of the revenue, while the foreign consumer's burden is -0.04 percent of the revenue.

with Table 1). When the domestic economy equals 37.5 percent of the world economy and the tax rate equals 6.25 percent, the combined measures of burden (Table A2) under the assumptions in Table A1 are much closer to the burdens predicted under the assumptions of the base case in this study (Table 1). Under the assumptions consistent with Harberger's (1995) application, domestic labor bears 87.1 percent of the burden. Domestic capital owners bear 21.3 percent of the tax. Although 87.1 percent and 73.7 percent are different, both numbers imply that domestic labor bears most, but not more than 100 percent, of the corporate income tax.

Harberger (1995, 2006) assumes that worldwide capital income is reduced by exactly 100 percent of the revenue from the corporate income tax. However, although capital owners worldwide bear slightly more than 100 percent of the corporate tax burden when effects on both the sources and uses of income are combined, that outcome does not occur when the measure of burden is based only on the sources. According to Equation (4), the reduction in worldwide capital income would not generally equal 100 percent of the revenue when the corporate income tax is imposed only on some domestic sectors. Under the assumptions (Table A1) consistent with Harberger (1995), worldwide capital income is reduced by 133.4 percent (50 percent + 83.4 percent) of the revenue when the 6.25 percent corporate income tax is imposed in the large economy (Table A2). Remarkably, when effects on the sources and uses of income are combined, capital owners worldwide bear 104.6 percent of the burden (21.3 percent + 83.3 percent).

According to Equation (14), the 100 percent share assumption made by Harberger (1995, 2006) would be true for a small general tax on capital imposed on all domestic sectors. Under the general replacement tax (not shown in Table A2) imposed in the large economy, worldwide

capital income falls by 101.6 percent of the revenue regardless of whether the sources and uses are combined in the measure of tax burden. The worldwide excess burden from that tax is 1.6 percent of the revenue.

For comparison, under the share assumptions from Table 1, worldwide capital income falls by 119.3 percent (35.8 percent + 83.5 percent) of the revenue when the 6.25 percent corporate income tax is imposed in the large economy (Table A2). Capital owners worldwide bear 104.7 percent (32.5 percent + 72.2 percent) of the burden when sources and uses are combined. Under the general replacement tax imposed in the large economy (not shown in Table A2), worldwide capital income falls by 102.5 percent of the revenue regardless of whether sources and uses are combined.

Gravelle and Smetters

Under the basic assumptions, the numerical results of this study are very close to the results in Gravelle and Smetters (2006) when those authors assume that international capital mobility is perfect, and that there is a nearly perfect demand substitution between the domestic and foreign internationally tradeable goods produced in the corporate sector. In that case, their simulations predict that domestic labor bears 73 percent of the burden, domestic capital owners bear 35 percent, foreign capital owners bears 67 percent, foreign labor bears -69 percent, and the worldwide excess burden equals about 5 percent of the revenue.⁴¹ In the base case (Table 3), the model used in this study predicts that domestic labor bears 74 percent, domestic capital owners

⁴¹ Gravelle and Smetters, Table 2.

bear 33 percent, foreign capital owners bear 72 percent, foreign labor bears -71 percent, and the excess burden equals about 4 percent of the revenue.

It is not surprising that the results of the two studies are so close. Even though the model applied in this study has an additional sector (sector one), the predictions should approximate the Gravelle and Smetters model when the tax rate is small and the authors assume that capital mobility is perfect and the internationally traded corporate goods are perfect substitutes. Further, both studies make the same assumptions about the sizes of sectors and the intensities of factor inputs.⁴²

The two studies produce very different results when there is a low degree of demand substitution between the foreign and domestic corporate tradeable goods. In that case, the predictions of the five-sector model used in this study do not depend directly on that degree of demand substitutability.⁴³ In contrast, the four sector model used by Gravelle and Smetters predicts that labor bears only 21 percent of the burden if capital is perfectly mobile and the international output demand substitution elasticity equals 1.

How the output demand substitution elasticity affects the predictions of the four sector model of Gravelle and Smetters can be readily understood in terms of the five-sector model used in this study. First, suppose that sector one of the five-sector model produces no output, and that sector four (agriculture) produces the numeraire. Now, the wage rate is determined in sector two. Unlike the base case in this study, both the domestic sector two output price and the domestic

⁴² Other assumptions might differ slightly between the studies, but the effects of those assumptions appear to be small. For example, when the partial substitution elasticity between capital and labor is increased to equal 1, the model used in this study predicts that the excess burden will equal about 6 percent; the burden shares are virtually unaffected.

⁴³ The only exception occurs if the demand substitution is (nearly) perfect and the capital intensities differ in the first two sectors. In that event, the more capital-intensive domestic sector will stop producing in response to the corporate tax; the foreign country will produce all of that good. The domestic wage rate will be determined in the remaining domestic corporate tradable sector.

wage rate can change when the corporate cost of capital is increased by the tax. If the demand substitution elasticity between the foreign and domestic corporate tradable goods is very high, the domestic wage rate must fall sufficiently to fully offset an increase in the corporate cost of capital, as in the five-sector economy. However, if the demand substitution elasticity is small, the domestic output price can increase in sector two. In that case, the domestic wage rate does not have to fall as much in order to offset the increased corporate cost of capital. Domestic consumer prices will increase compared to equilibria when the demand substitution elasticity is high, offset somewhat by improved international terms of trade for the domestic economy. However, the real burden for domestic labor will be smaller than when the output demand substitution elasticity is higher. Further, because that demand substitution elasticity does not affect the international allocation of capital, domestic capital owners will bear a slightly larger burden because they will have to pay higher consumer prices than when the demand substitution elasticity is higher.

When the demand substitution elasticity is low for outputs of the corporate tradable sector, each country has some potential market power in international trade, even though competition is perfect at the level of the individual firm. In part, the domestic corporate tax can act like a domestic tariff on exports from the corporate sector. Under either the corporate tax or such a tariff, the domestic national income is increased at the expense of a decrease in the foreign national income. Domestic capital owners still earn roughly the same nominal return under the corporate tax as when the demand substitution elasticity is higher, but they must pay higher consumer prices, so the domestic capital owners' burden is higher when the substitution elasticity is lower. Domestic labor's burden is decreased by the rise in domestic national income when the

substitution elasticity is low. When the output demand substitution and capital mobility are perfect, foreign residents overall do not bear any burden of the tax. However, when the output demand substitution elasticity is only 1, the Gravelle and Smetters model predicts that the tariff-like effect allows the domestic economy to export about half of the total burden of its corporate income tax to foreigners.

The Gravelle and Smetters model, in effect, allows the authors to measure how the corporate tax might affect the distribution of burdens through its effects on international trade when the domestic country has some world monopoly power. The analysis in this study indicates that the trade effects and burdens will be different when there are additional corporate sectors that produce goods with higher rates of output demand substitutability between the domestic and foreign varieties. A recent study by Erkel-Rousse and Mirza (2002) estimated import price elasticities based on bilateral trade equations. They estimate larger elasticities for certain products such as rubber (-6.5) and non-metallic products (-6.6) than for other products such as beverages (-1.7) and food products (-1.0). Further, even their average elasticity estimate is fairly large: They estimate an average elasticity of -3.8 for all industries. Reasonable long-run elasticities are likely to be even larger.⁴⁴

⁴⁴ See also McDaniel and Balistreri (2003) for a survey of trade elasticities.

Table 1: Initial Assumptions

	<u>Share of Value Added in Sector</u>			<u>Share of Output</u>
	<u>Labor</u>	<u>Capital</u>	<u>Land</u>	
<u>Corporate Sectors</u>				
Sectors 1 and 2: Tradeable	82%	18%	...	28%
Sector 3: Nontradeable	76%	24%	...	45%
<u>Non-Corporate Sectors</u>				
Sector 4: Tradeable, agriculture	49%	17%	34%	3%
Sector 5: Nontradeable	<u>47%</u>	<u>53%</u>	<u>...</u>	<u>24%</u>
Total	70%	29%	1%	100%
Domestic economy's share of world output		30%		
Domestic ownership share of world capital		30%		
Partial elasticity of substitution, capital and labor		0.6		

Source: Based on Gravelle and Smetters (2006).

Table 2: Economic Changes under Corporate and General Taxes

	<u>Corporate Tax</u>		<u>General Tax</u>	
	<u>Domestic</u>	<u>Foreign</u>	<u>Domestic</u>	<u>Foreign</u>
Tax rate (tax-exclusive)				
Corporate sectors	6.25%	0.0%	3.35%	0.0%
Noncorporate sectors	0.0%	0.0%	3.35%	0.0%
Capital stock changes				
Corporate sectors	-3.7%	0.85%	-1.7%	0.73%
Noncorporate sectors	<u>0.036%</u>	<u>0.85%</u>	<u>-1.7%</u>	<u>0.73%</u>
Total (weighted by capital shares)	-2.0%	0.85%	-1.7%	0.73%
Input price changes				
<u>Cost of capital</u>				
Corporate sectors	5.0%	-1.2%	2.3%	-0.99%
Noncorporate sectors	-1.2%	-1.2%	2.3%	-0.99%
Wage rate	-1.1%	0.25%	-0.51%	0.22%
Land rent	2.2%	0.21%	-0.43%	0.18%
Consumer price changes				
<u>Corporate sectors</u>				
Sector 1: Tradeable, numeraire	0.0%	0.0%	0.0%	0.0%
Sector 2: Tradeable, unique	0.0%	0.0%	0.0%	0.0%
Sector 3: Nontradeable	0.37%	-0.085%	0.17%	-0.07%
<u>Non-corporate sectors</u>				
Sector 4: Tradeable, agriculture	0.0%	0.0%	0.0%	0.0%
Sector 5: Nontradeable	<u>-1.1%</u>	<u>-0.5%</u>	<u>0.99%</u>	<u>-0.42%</u>
Total (Laspeyres)	-0.11%	-0.16%	0.31%	-0.13%
Private income changes (real)				
Labor	-0.99%	0.41%	-0.82%	0.35%
Capital	-1.1%	-1.0%	-1.3%	-0.86%
Land	<u>2.3%</u>	<u>0.37%</u>	<u>-0.74%</u>	<u>0.32%</u>
Total (weighted by income shares)	-0.978%	0.00%	-0.963%	0.00%
Tax revenue (percentage of output)	0.944%	0.00%	0.944%	0.00%
National income (percentage of revenue)	-3.70%	0.00%	-2.05%	0.00%
Worldwide income (percentage of revenue)	-3.70%		-2.05%	

Table 3: Burdens of the Corporate Income Tax

	Labor	Capital	Land	Total
Domestic Taxes on Capital Income at Producer Level; Burdens as Shares of Revenue				
<u>Corporate Tax</u>				
Domestic	73.7%	32.5%	-2.5%	103.7%
Foreign	<u>-71.3%</u>	<u>72.2%</u>	<u>-0.9%</u>	<u>0.0%</u>
Worldwide	2.4%	104.7%	-3.4%	103.7%
<u>General Tax</u>				
Domestic	61.0%	40.3%	0.8%	102.0%
Foreign	<u>-61.0%</u>	<u>61.8%</u>	<u>-0.8%</u>	<u>0.0%</u>
Worldwide	0.0%	102.0%	0.0%	102.0%
Replacement Taxes; Differential Burdens as Shares of Revenue				
<u>General Tax</u>				
Domestic	-12.7%	7.8%	3.3%	-1.7%
Foreign	<u>10.3%</u>	<u>-10.4%</u>	<u>0.1%</u>	<u>0.0%</u>
Worldwide	-2.4%	-2.7%	3.4%	-1.7%
<u>Domestic Labor Income</u>				
Domestic	26.3%	-32.5%	2.5%	-3.7%
Foreign	<u>71.3%</u>	<u>-72.2%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	97.6%	-104.7%	3.4%	-3.7%
<u>Worldwide Capital Income of Domestic Residents</u>				
Domestic	-73.7%	67.5%	2.5%	-3.7%
Foreign	<u>71.3%</u>	<u>-72.2%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	-2.4%	-4.7%	3.4%	-3.7%
<u>Domestic Personal Income or Consumption</u>				
Domestic	-3.8%	-3.4%	3.5%	-3.7%
Foreign	<u>71.3%</u>	<u>-72.2%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	67.5%	-75.6%	4.4%	-3.7%

Table 4: Burdens of the Corporate Income Tax at an Infinitesimal Tax Rate

	Labor	Capital	Land	Total
Domestic Taxes on Capital Income at Producer Level; Burdens as Shares of Revenue				
<u>Corporate Tax</u>				
Domestic	71.0%	31.3%	-2.4%	100.0%
Foreign	<u>-68.7%</u>	<u>69.6%</u>	<u>-0.9%</u>	<u>0.0%</u>
Worldwide	2.3%	101.0%	-3.3%	100.0%
<u>General Tax</u>				
Domestic	59.7%	39.5%	0.8%	100.0%
Foreign	<u>-59.7%</u>	<u>60.5%</u>	<u>-0.8%</u>	<u>0.0%</u>
Worldwide	0.0%	100.0%	0.0%	100.0%
Replacement Taxes; Differential Burdens as Shares of Revenue				
<u>General Tax</u>				
Domestic	-11.3%	8.1%	3.2%	0.0%
Foreign	<u>9.0%</u>	<u>-9.1%</u>	<u>0.1%</u>	<u>0.0%</u>
Worldwide	-2.3%	-1.0%	3.3%	0.0%
<u>Domestic Labor Income</u>				
Domestic	29.0%	-31.3%	2.4%	0.0%
Foreign	<u>68.7%</u>	<u>-69.6%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	97.7%	-101.0%	3.3%	0.0%
<u>Worldwide Capital Income of Domestic Residents</u>				
Domestic	-71.0%	68.7%	2.4%	0.0%
Foreign	<u>68.7%</u>	<u>-69.6%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	-2.3%	-1.0%	3.3%	0.0%
<u>Domestic Personal Income or Consumption</u>				
Domestic	-1.1%	-2.3%	3.4%	0.0%
Foreign	<u>68.7%</u>	<u>-69.6%</u>	<u>0.9%</u>	<u>0.0%</u>
Worldwide	67.6%	-71.9%	4.3%	0.0%

**Table 5: International Spillover Effects
of a Domestic Corporate Income Tax**

	<u>Burden as a Share of Revenue</u>			
	<u>Labor</u>	<u>Capital</u>	<u>Land</u>	<u>Total</u>
Base Case (from Table 3)				
Domestic	73.7%	32.5%	-2.5%	103.7%
Foreign	<u>-71.3%</u>	<u>72.2%</u>	<u>-0.9%</u>	<u>0.0%</u>
Worldwide	2.4%	104.7%	-3.4%	103.7%
Domestic Country is a Net International Lender				
Domestic	73.7%	37.9%	-2.5%	109.1%
Foreign	<u>-71.3%</u>	<u>67.0%</u>	<u>-0.9%</u>	<u>-5.2%</u>
Worldwide	2.4%	105.0%	-3.4%	104.0%
Domestic Country is a Net International Borrower				
Domestic	73.7%	27.1%	-2.5%	98.3%
Foreign	<u>-71.3%</u>	<u>77.4%</u>	<u>-0.9%</u>	<u>5.2%</u>
Worldwide	2.4%	104.4%	-3.4%	103.4%
Sector 2 is More Capital-Intensive than Sector 1				
Domestic	59.0%	37.5%	-1.6%	94.9%
Foreign	<u>-57.0%</u>	<u>67.0%</u>	<u>-1.3%</u>	<u>8.7%</u>
Worldwide	2.0%	104.5%	-2.9%	103.7%
Sector 2 is Less Capital-Intensive than Sector 1				
Domestic	90.6%	26.7%	-3.5%	113.9%
Foreign	<u>-87.8%</u>	<u>78.2%</u>	<u>-0.5%</u>	<u>-10.1%</u>
Worldwide	2.8%	104.9%	-4.0%	103.7%

Table 6: Economic Changes under a Corporate Income Tax When Capital Intensities Differ

	Capital Intensity in Sector Two Compared with Sector One					
	<u>Same Intensity</u>		<u>Higher Intensity</u>		<u>Lower Intensity</u>	
	<u>Domestic</u>	<u>Foreign</u>	<u>Domestic</u>	<u>Foreign</u>	<u>Domestic</u>	<u>Foreign</u>
Tax rate (tax-exclusive)						
Corporate sectors	6.25%	0.00%	6.25%	0.00%	6.25%	0.00%
Non-corporate sectors	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Capital stock changes						
Corporate sectors	-3.67%	0.85%	-3.46%	0.76%	-3.92%	0.96%
Noncorporate sectors	<u>0.04%</u>	<u>0.85%</u>	<u>0.25%</u>	<u>0.76%</u>	<u>-0.21%</u>	<u>0.96%</u>
Total (weighted by capital shares)	-1.98%	0.85%	-1.77%	0.76%	-2.23%	0.96%
Input price changes						
<u>Cost of capital</u>						
Corporate sectors	5.02%	-1.16%	5.07%	-1.11%	4.96%	-1.21%
Noncorporate sectors	-1.16%	-1.16%	-1.11%	-1.11%	-1.21%	-1.21%
Wage rate	-1.10%	0.25%	-0.69%	0.15%	-1.57%	0.38%
Land rent	2.17%	0.21%	1.55%	0.34%	2.86%	0.05%
Consumer price changes						
<u>Corporate sectors</u>						
Sector 1: Tradeable, numeraire	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sector 2: Tradeable, unique	0.00%	0.00%	0.46%	-0.10%	-0.52%	0.13%
Sector 3: Nontradeable	0.37%	-0.08%	0.69%	-0.15%	0.00%	0.00%
<u>Non-corporate sectors</u>						
Sector 4: Tradeable, agriculture	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sector 5: Nontradeable	<u>-1.13%</u>	<u>-0.50%</u>	<u>-0.91%</u>	<u>-0.52%</u>	<u>-1.38%</u>	<u>-0.46%</u>
Total (Laspeyres)	-0.11%	-0.16%	0.11%	-0.18%	-0.35%	-0.13%
Private income changes (real)						
Labor	-0.99%	0.41%	-0.80%	0.33%	-1.22%	0.51%
Capital	-1.05%	-1.00%	-1.22%	-0.93%	-0.87%	-1.09%
Land	<u>2.27%</u>	<u>0.37%</u>	<u>1.45%</u>	<u>0.52%</u>	<u>3.21%</u>	<u>0.18%</u>
Total (weighted by income shares)	-0.98%	0.00%	-0.90%	-0.04%	-1.07%	0.04%
Tax revenue (percentage of output)	0.94%	0.00%	0.94%	0.00%	0.94%	0.00%
National income (percentage of revenue)	-3.70%	0.00%	5.06%	-8.75%	-13.85%	10.13%
Worldwide income (percentage of revenue)	-3.70%		-3.69%		-3.72%	

**Table 7: Corporate Tax Burden Shares and Relative Economy Size,
Burdens Measured on an Aggregate Basis^a**

	Share of World Output	Burden as a Share of Revenue			
		Labor	Capital	Land	Total
Domestic	1%	104.3%	2.6%	-2.1%	104.8%
Foreign	99%	-101.9%	103.2%	-1.3%	0.0%
Domestic	5%	100.0%	6.8%	-2.1%	104.7%
Foreign	95%	-97.6%	98.9%	-1.3%	0.0%
Domestic	10%	94.7%	12.0%	-2.2%	104.5%
Foreign	90%	-92.3%	93.5%	-1.2%	0.0%
Domestic	20%	84.1%	22.3%	-2.3%	104.1%
Foreign	80%	-81.7%	82.8%	-1.1%	0.0%
Domestic	30%	73.7%	32.5%	-2.5%	103.7%
Foreign	70%	-71.3%	72.2%	-0.9%	0.0%
Domestic	50%	52.9%	52.7%	-2.7%	103.0%
Foreign	50%	-50.5%	51.2%	-0.7%	0.0%
Domestic	70%	32.5%	72.7%	-3.0%	102.2%
Foreign	30%	-30.1%	30.5%	-0.4%	0.0%
Domestic	90%	12.3%	92.4%	-3.2%	101.5%
Foreign	10%	-10.0%	10.1%	-0.1%	0.0%
Domestic	~100%	2.3%	102.2%	-3.3%	101.2%
Foreign	~0%	0.0%	0.0%	0.0%	0.0%

^a Total burdens divided by total domestic revenue

**Table 8: Corporate Tax Burden Shares and Relative Economy Size,
Burdens Measured on a Per Capita Basis^a**

	Share of World Output	Per Capita Burden Shares			
		Labor	Capital	Land	Total
Domestic	1%	104.3%	2.6%	-2.1%	104.8%
Foreign	99%	-1.0%	1.0%	0.0%	0.0%
Domestic	5%	100.0%	6.8%	-2.1%	104.7%
Foreign	95%	-5.1%	5.2%	-0.1%	0.0%
Domestic	10%	94.7%	12.0%	-2.2%	104.5%
Foreign	90%	-10.3%	10.4%	-0.1%	0.0%
Domestic	20%	84.1%	22.3%	-2.3%	104.1%
Foreign	80%	-20.4%	20.7%	-0.3%	0.0%
Domestic	30%	73.7%	32.5%	-2.5%	103.7%
Foreign	70%	-30.5%	30.9%	-0.4%	0.0%
Domestic	50%	52.9%	52.7%	-2.7%	103.0%
Foreign	50%	-50.5%	51.2%	-0.7%	0.0%
Domestic	70%	32.5%	72.7%	-3.0%	102.2%
Foreign	30%	-70.3%	71.2%	-0.9%	0.0%
Domestic	90%	12.3%	92.4%	-3.2%	101.5%
Foreign	10%	-89.7%	90.9%	-1.2%	0.0%
Domestic	~100%	2.3%	102.2%	-3.3%	101.2%
Foreign	~0%	0.0%	0.0%	0.0%	0.0%

^a Local per capita burdens divided by domestic per capita revenue.

Table A1: Shares Consistent with Harberger (1995)

	<u>Share of Value Added in Sector</u>			<u>Share of Output</u>
	<u>Labor</u>	<u>Capital</u>	<u>Land</u>	
<u>Corporate sectors</u>				
Sectors 1 and 2: Tradeable	71%	29%	...	25%
Sector 3: Nontradeable	82%	18%	...	40%
<u>Non-corporate sectors</u>				
Sector 4: Tradeable, agriculture	49%	17%	34%	3%
Sector 5: Nontradeable	<u>57%</u>	<u>43%</u>	<u>...</u>	<u>32%</u>
Total	70%	29%	1%	100%
Domestic economy's share of world output		37.5%		
Domestic ownership share of world capital		37.5%		
Partial elasticity of substitution, capital and labor		0.6		

Sources: Based on Harberger (1995) and Gravelle and Smetters (2006).

Table A2: Reconciliation with Harberger (1995)

		Sources and Uses	<u>Burden as a Share of Revenue</u>				Total
			Labor	Capital	Land	Consumers	
Small Economy, Infinitesimal Tax Rate, Shares from Table A1							
Domestic	separate		200.0%	0.0%	-4.2%	-95.8%	100.0%
Foreign	separate		-129.3%	129.3%	0.4%	-0.4%	0.0%
Domestic	combined		132.9%	-27.8%	-5.1%	...	100.0%
Foreign	combined		-129.6%	129.2%	0.4%	...	0.0%
Large Economy, 6.25 Percent Tax Rate, Shares from Table A1							
Domestic	separate		156.4%	50.0%	-4.1%	-99.1%	103.3%
Foreign	separate		-83.4%	83.4%	0.3%	-0.3%	0.0%
Domestic	combined		87.1%	21.3%	-5.1%	...	103.3%
Foreign	combined		-83.6%	83.3%	0.3%	...	0.0%
Large Economy, 6.25 Percent Tax Rate, Shares from Table 1							
Domestic	separate		81.6%	35.8%	-2.3%	-11.3%	103.7%
Foreign	separate		-44.1%	83.5%	-0.5%	-38.9%	0.0%
Domestic	combined		73.7%	32.5%	-2.5%	...	103.7%
Foreign	combined		-71.3%	72.2%	-0.9%	...	0.0%

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