Corporate and Personal Taxation of Capital Income in an Open Economy

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OTA Paper 55 March 1984

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Office of Tax Analysis
U.S. Treasury Department, Room 4040
Washington, D.C. 20220
Issued: April 1984

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I. Introduction

Increased public concern in the 1970s over stagnating U.S. economic growth and declining international competitiveness of basic U.S. industries has resulted in greater attention being focussed on the recent low rates of U.S. capital formation. Proposals to promote more rapid capital accumulation have centered on changes in the taxation of capital income, at both the personal and corporate levels. This paper simulates the likely effects of such policy changes on the returns to capital and on the size of the capital stock, within a model which allows for international trade and capital flows.

The results suggest that only a modest degree of capital mobility is necessary to substantially alter the conclusions drawn from analyses based on a closed economy. When corporate taxes are reduced, after-tax returns to capital rise only slightly because of the reallocation of capital to the United States. When personal taxes are reduced, the after-tax return to capital owned by U.S. investors rises by more than the tax reduction. In part, this is because sectoral differences in taxes on capital income interact with the way international investment income is taxed to cause an outflow of U.S. capital.

Because there already is an extensive literature on the incidence of capital taxation, plus many empirical projections based on the theory developed, a few comments are warranted at the outset to indicate how this paper relates to past work and what new insights it provides. Harberger's (1962) seminal analysis of the incidence of the corporate income tax in a static, closed economy, two-sector model of the United States suggested that capital bore almost the entire burden of the tax. However, if private savings are responsive to after-tax rates of return, and corporate taxation is considered in a framework where capital formation is possible (Ballentine 1978), then, even in a closed economy, owners of capital can avoid a significant portion of the burden of the tax.

The international implications of tax policy changes at the personal or corporate level have not gone unnoticed. It has been recognized that additional savings generated by cuts in personal income taxes on capital income may flow abroad rather than being invested at home. This result becomes more likely when capital is highly mobile internationally and the country considered is small relative to the rest of the world. Harberger (1978) calculates that real rates of return are fairly similar across countries,and attributes this result to a high degree of capital mobility internationally. In that case corporate tax reductions

will be more successful in expanding the domestic capital stock than personal tax cuts. In countering this view, Feldstein and Horioka (1980) present evidence that capital essentially is immobile internationally, and conclude "it is appropriate, at least as an approximation, to study income distribution in general, and tax incidence in particular, with models that ignore international capital mobility" (p. 328).

Goulder, Shoven and Whalley (1982) extended the earlier Shoven-Whalley domestic tax model to assess the extent of welfare changes from corporate and personal tax reductions, allowing for varying degrees of capital mobility internationally. The present paper pursues a closely related issue, projecting the incidence of taxes on capital income. A two country, three factor, three good, general equilibrium framework is developed. In contrast to the Goulder analysis, the present formulation explicitly considers production in the rest of the world and allows international capital flows to affect foreign production capabilities. Also, an attempt is made to model accurately the way in which investment income produced in one country is taxed when received by residents of another. This is necessary in order to correctly project how the relative attractiveness of foreign and domestic

investments changes when personal or corporate taxes are reduced in the United States. Additionally, the model is presented in terms of own and cross price elasticities of demand for foreign and domestic assets, which may make the results easier to interpret.

This framework is used to assess empirically how changes in capital taxation affect after tax returns to capital, steady state saving patterns, and the size of the capital stock available in the United States. As suggested above, the results caution against the sweeping judgment of Feldstein and Horioka that tax incidence can safely be carried out in a closed economy setting.

II. An Analytical Model of an Open Economy

The model presented here builds on earlier work by the authors (Mutti and Grubert 1982) which assessed the effects of export promotion policies through favorable tax treatment of export income. The industry aggregations represent a compromise between the best groupings for trade analysis and the best for tax analysis, within a model small enough to allow an intuitive understanding of the main factors which operate. The corporate tax in this model is therefore a combination of a general tax on capital in all sectors and a sectoral tax on capital in the traded good sectors.

To briefly summarize this approach, two countries are modelled, the United States and the rest of the world. Both countries produce three goods, and the production of all goods is assumed to require three factors of production, unskilled labor, skilled labor, and capital. The three goods represent a net export good, a net import good, and a nontraded good. However, domestic output in an industry is not assumed to be perfectly substitutable with output from the same industry in the other country. Therefore, consumers in each country allocate income among the four tradable goods and their domestic nontradable good. The model is not simply a comparative static one in which all factor supplies are held constant. While not fully dynamic, it looks at the way in which factor supplies, output, and factor rewards change from one steady state solution to another after a change in tax policy is adopted. Thus, the model explicitly considers the way capital formation is affected by tax policy.

For the sake of brevity, only typical elements from each of the blocs of the model are presented. To begin with more familiar features, production or supply conditions are described first. The notation of Jones (1965) is used, which also has been applied in addressing several issues in public finance (see, for example, Vandendorpe and Friedlaender 1976). In each country perfectly competitive output and factor markets are assumed. Production functions are assumed to be strictly quasi concave and linear homogeneous.

One basic portion of the model is based on the condition that zero economic profits be earned in all industries. For industry X_{1A} the appropriate equation is

$$C^A_{L1}\ w_a + C^A_{H1}\ q_A + C^A_{K1}\ r_A/(1-t^A_{ci})(1-t^A_{pi}) = P_{1A} \qquad (1)$$

where C^k_{ij} is the amount of input i necessary to produce one unit of output j in country k. Factor rewards of unskilled labor, L, skilled labor, H, and capital, K, are represented by w, q, and r, respectively, and P_{1A} is the price of good one produced by country j. The term t^A_{ci} is the rate of taxation of capital income at the corporate level in sector i in Country A, and t^A_{pi} the rate of taxation of capital income at the personal level.

The gross return to capital is the relevant cost to the producer, and it is assumed to equal the value of the marginal product of capital, m. The marginal product of capital after taxation at both the corporate and personal levels is represented by r, and thus, $m(1-t_c)(1-t_p)= r$. The after-tax return faced in each domestic sector is assumed to be the same, but due to differences in taxation at the corporate and personal levels, before tax costs of capital differ across sectors. Equation (1) shows that a cut in capital taxation at either level will allow U.S. producers to reduce the price charged for their output.

A second element of the model is based on the condition that factors of production be fully employed. For the case of unskilled labor in Country A, quantity demanded is shown as:

$$C^A_{L1} X_{1A} + C^A_{L2} X_{2A} + C^A_{LN} X_{NA} = L_A \qquad (2)$$

where X_{iA} represents output of the ith good in Country A, and L_A is the quantity of unskilled labor supplied. The input-output coefficients depend upon relative before-tax factor prices. A reduction in either tax variable reduces the desired ratio of labor to capital per unit of output, with the size of this adjustment depending importantly upon the relevant partial elasticity of substitution in production. These factor demand equations are set equal to the factor supply equations developed below.

A third important element of the model expresses product demand conditions. Based on national income account categories, demand for U.S. produced goods will depend upon purchases by consumers, private investors, the government and the foreign sector. In this model, no distinction is made between consumers and the government, as if the government redistributed any revenues to consumers or bought exactly the same mix of goods as consumers. This component of demand is considered first. For each good, quantity demanded will depend upon relative prices, inclusive of

tariffs, and on current income, Y, less savings, S. In other words, consumers are assumed to treat current and future consumption as separable, so that choices among current consumptions goods simply depend on current relative prices and total consumption expenditure in the present period. As shown for Country A, a nation's current income is determined by the value of its output, plus net foreign investment income, plus tariff revenue:

$$Y_A = P_{1A}X_{1A} + P_{2A}X_{2A} + X_{NA} + \frac{r_B}{(1-t_P)} K_B^A - \frac{r_A}{(1-t_P)} K_A^B + TAR_{1A} P_{1B} X_{1BA} + TAR_{2A} P_{2B} X_{2BA} \quad (3)$$

where K_j^i is country i's ownership of assets in country j, X_{ijk} is sales in country k of good i produced by country j, and TAR is the ad valorem tariff rate imposed by Country A.

The two capital terms included indicate that foreign investment is a two way flow, attributed here to the desire of investors to diversify their asset holdings. The appropriate return from this investment abroad to be included in the determination of national income is approximated as what is received after foreign taxation at the corporate level. For instance, foreign investors are assumed to pay taxes at the corporate level in the United States, but they do not face U.S. personal income tax on those earnings.[1] With respect to U.S. foreign investment, the majority occurs through corporations, who are not subject to U.S.

corporate taxes on income reinvested abroad. Any distribution to the United States receive a tax credit for payments of income taxes to foreign governments, up to the value of their U.S. corporate income tax liability on that income. U.S. firms have tended to repatriate income to the United States such that foreign income taxes paid plus foreign withholding taxes approximately equal their corresponding U.S. tax liability. Therefore, separate treatment of withholding taxes is not included in the U.S. current income measure.

To determine product demands attributable to private investment requires a more general explanation of how capital formation is treated in this model. There is no specific capital goods sector. Rather, capital is a composite fabricated from the five

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[1] The United States imposes a statutory withholding rate of 30 percent on interest and dividends paid to nonresidents, but in practice the average withholding rate is less than two percent. Many U.S. tax treaties establish lower rates for residents of treaty countries, while some types of income, such as interest on bank accounts, are entirely exempt from withholding taxes by statute.

goods available in each country, and we assume that the mix of goods required in creating new capital is the same as when demanded by consumers. The composite capital good itself is assumed not to move in international trade and because demand in each country contains a large component of nontraded goods, this means that the price of capital goods can be different in the two countries.[2]

Also, because there are no explicit financial markets in this model, demands for capital goods are derived directly from savings. Consequently, in a purely closed economy with no capital flows, the amount of savings in A, S^A, would have no impact on the pattern of commodity demands. However, if residents of A allocate part of their savings to acquire capital goods in B, shown as S_B^A, this amount must be subtracted from national income, Y_A, to derive the appropriate scale variable, or budget constraint, in each commodity demand function. When B residents choose to invest in A, then an addition to total expenditure in A, equal to S_A^B, must be made. Therefore, the scale or aggregate

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2 Even if there were an explicit capital equipment sector, the composite price of capital would still differ between the two countries because of the nontraded capital goods such as structures. It is also necessary to distinguish between trade in machines, which reflects comparative advantage in production, from capital flows, which reflect differences in rates of return and asset preferences.

expenditure variable in the commodity demand equations of A residents is $Y_A - S_B^A + S_A^B$, and in commodity demands by B residents, it is $Y_A - S_A^B + S_B^A$.

Finally, foreign sector demand for A's tradable goods will depend upon relative prices in Country B and on the B scale variable described above, while A's demand for imports are determined by relative prices in A and the scale variable in A. An explicit balance of payments equation is not necessary, since it is implicit in the derivation of the scale variable.[3] Expenditures in a country, including the demand for imports, can exceed output when foreigners choose to invest in it, and conversely, if a country wants to increase its net foreign investment, national production must be greater than domestic expenditures. This is identical to the standard formulation in which the U.S. current account must be in surplus when U.S. investment abroad rises. Tax policy changes which increase proportionally the returns from all forms of saving will increase the U.S. current account surplus. Specification of this saving behavior represents another important aspect of the model.

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[3] Equilibrium conditions explicitly included in the model are that quantity supplied equal quantity demanded domestically in the nontraded sector, and that quantity supplied equal the sum of quantities demanded in both foreign and domestic markets for traded goods. Since the system is comprised of ten goods, market balance equations for only nine of them need be included.

Savings by residents of each country are assumed to depend on income and on rates of return after taxes both at the corporate and personal level. Savers in any country can invest both in domestic real capital or in capital abroad. Although foreign and domestic investment are not regarded as perfect substitutes, an increase in after-tax returns in one location relative to another will attract more investment from both foreign and domestic savers.

The two savings functions in Country A are represented as

$$S_A^A = f_{AA}\ (i_A^A,\ i_B^A,\ Y_A) \tag{4}$$

$$S_B^A = f_{AB}\ (i_A^A,\ i_B^A,\ Y_A) \tag{5}$$

where i_A^A and i_B^A are the percentage rates of return after tax at both the corporate and personal level obtained by A savers from investments in A and B, respectively. The percentage rate of return is derived from the after-tax value marginal product of capital, $\dot{r}$, divided by the price of capital, which in this model will be a weighted average of the prices of the five goods which represent capital. The symbol used for this capital price index is CPI.

However, the savings equations must distinguish between after-tax returns received by A and B investors in the same location, e.g., between i_A^A and i_A^B, because in general they will be subject to different rates of personal tax on identical investments. The percentage return to capital after taxation at the personal level, i_A, must be modified to recognize what tax is relevant to savers. The return i_A can appear without change in A's saving equations, to represent the return received by A savers who invest in A. To find the appropriate expression for B savers, first derive the after corporate tax percentage rate of return in terms of i, which is $i_A^A/(1-t_P^A)$. Therefore, B investors who invest in A receive $i_A^B = i_A^A(1-t_P^B)/(1-t_P^A)$, where t_P^B is the personal tax paid by B residents.

This substitution for i_A^B is straightforward when there is a single personal level of tax, t_P^A, in A. In fact there are sectoral differences, because differing portions of investment income are taxable at the personal level, particularly because of the exemption of homeowners returns. Therefore, there is not a unique t_P^A. In the implementation of the model, the U.S. personal tax rate on income earned in the traded goods sector is used to determine the corporate level income received by foreign inves-

tors. That choice is appropriate because foreigners would choose to invest in the sector with the highest after corporate tax return; if domestic savers are to receive the same return in all sectors, then foreigners will find it most profitable to invest in the sector with the highest U.S. personal tax rate.[4]

Given projected changes in saving of the form shown above, the change in nominal investment in A is equal to $a\hat{S}_A^A + (1-a)\hat{S}_A^B$, where a is the share of the capital stock owned by A residents, and a carat denotes the percentage change in a variable. In the steady state assumed in this analysis, the rate of growth of the real capital stock is constant and equal to the sum of exogenous growth of the labor force and Harrod-neutral productivity growth. This means that in the steady state any increase in investment must be proportional to the increase in the capital stock. That is, in the steady state,

$$\frac{S_A/CPI_A}{K_A} = c \qquad (6)$$

where S_A/CPI_A is nominal investment in A divided by the price of capital goods, and c is the exogenous steady state rate of growth. This permits us to determine the change in the capital stock from one steady state to another as $\hat{K}_A = \hat{S}_A - \hat{CPI}$. There is an analogous equilibrium condition for $\hat{K}_B$.

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4 This scenario implicitly assumes that foreign investment does not exceed overall investment requirements in the traded goods sector.

Supplies of the two labor inputs, unskilled and skilled labor, are derived from simple model of investment in human capital. Unskilled workers acquire human capital by undergoing training at the beginning of their careers. The training process requires no capital or other labor inputs, and workers undergoing training produce no output.

$$L = (1-st)\ N \tag{7}$$

$$H = (1-st)\ h\ N \tag{8}$$

where st is the share of the labor force in training, h is the amount of human capital per worker, and N is the total labor force. The amount of human capital per worker, and in turn the share of the labor force in training in the steady state, respond to changes in the ratio of skilled to unskilled wages and to the real interest rate. This aspect of the model is described more fully in Appendix C.

III. Parameterization of the Model

The behavioral equations and market balance conditions explained above comprise the theoretical model used to analyze changes in U.S. taxation of capital income at both the corporate and personal level. The model contains a relatively small number of sectors and is solved in differential form so that analytical solutions could be derived from it. However the purpose of this paper is to evaluate the quantitative significance of certain effects rather than simply their direction. Empirical simulations are therefore necessary, which is equivalent to solving the model analytically and putting in empirical parameters. A summary of the necessary data and parameter values is presented here. (Appendix A gives examples of some of the basic equations in differential form.)

The three aggregate goods produced in each country were created from the 85 sector input output table of the United States. Non-traded goods and services, X_{NA}, basically were considered to be utilities, construction, transporation and communication, wholesale and retail trade, social and personal services, finance, banking and real estate, and government. U.S. net export goods, X_{2A}, essentially were grains, chemicals, and machinery. U.S. net import goods, X_{1A}, included many consumer durables and nondurables.

Allocations of factor inputs across industries are based upon the direct and indirect factor requirements necessary to produce current levels of output. Industry value added is only broken into capital and labor returns, and consequently a further calculation is necessary to determine skilled and unskilled labor utilization. Industry employment data is multiplied by the annualized minimum wage to indicate the return to unskilled labor in an industry, and the remainder of labor value added is attributed to skilled labor. By assuming that wage rates across industries are identical, these value added figures also can be used to infer the physical allocation of resources. With respect to general statements which characterize U.S. industry, the non-traded sector has above average capital requirements, unskilled labor requirements well above average, and skilled labor requirements well below average. The export sector has skilled labor requirements well above average, and unskilled labor requirements well below average, while the import sector is slightly less skill intensive and slightly more unskilled labor intensive than exports.

Partial elasticities of substitution between capital and unskilled labor, unskilled labor and skilled labor, and capital and skilled labor are based on estimates reported in Hammerseh and Grant (1980). The values applied to all industries in the

study are: $\sigma_{KL} = \sigma_{LS} = .60$, and $\sigma_{KS} = .05$. In other words, a very low degree of substitution between capital and skilled labor is assumed relative to the other trade-offs in factor usage.

Demand elasticities are generated from the assumption of utility tree functions of the following form:

$$U_A = U_A\ [(X_{1A}, X_{1B}), (X_{2A}, X_{2B}), X_{NA}] \tag{9}$$

$$U_B = U_B\ [(X_{1A}, X_{1B}), (X_{2A}, X_{2B}), X_{NB}] \tag{10}$$

If this nested utility function is CES in form, then as shown by Armington (1969), own and cross-price elasticities of demand can be derived directly from information regarding expenditure shares and elasticities of substitution at different levels of the utility tree. (The details of this derivation are presented in Appendix B.)

To form a consistent aggregate such as X_1 requires that X_{1A} and X_{1B} have identical income elasticities of demand. A stronger condition is imposed here, that all income elasticities equal one. The elasticity of substitution between the two traded goods in the same utility tree is assumed to be 3, the corresponding elasticity between the three general categories X_1, X_2 and X_N is assumed to be 1.25, and the elasticity of demand for all current

consumption as an aggregate is -1. As examples of what these values imply with respect to more commonly estimated parameters, the import elasticity of demand in the U.S. for X_{1B} equals -2.69, and the elasticity of demand for U.S. exports of X_{2A} to the rest of the world equals -2.79.

The savings elasticities are computed in a manner analogous to the commodity demand elasticities. Given the Armington separability assumption for foreign and domestic assets within the overall savings branch, two key parameters must be specified, the elasticity of substitution between foreign and domestic investment, σ, and the elasticity of overall saving with respect to the weighted worldwide after tax rate of return, η. Because these parameter values are not well established, a range of estimates is used: σ equal to zero, one, three and three hundred; and η equal to 0.0 and 0.4. The two extreme values of σ represent no substitutability between U.S. and foreign investment, and to virtually perfect substitutability; the intermediate values correspond to the elasticity of substitution between U.S. and foreign goods, and a still smaller value. The overall saving elasticity values correspond to the cases of zero interest elasticity of savings, and to 0.4, the value estimated by Boskin.

Tax rates at the business level are average effective rates, not marginal tax rates calculated from hypothetical investments and statutory provisions, which would be conceptually more

appropriate. The estimates used are based on the effective tax rates computed by Ballard, et al (1982). The tax rates reflect corporate income and property taxes as a share of total capital income. Personal tax rates reflect both marginal tax rates for capital income and the percentage of income after business-level taxation that is taxable at the personal level. This latter percentage is based both on distribution rate of corporations, and special factors in certain sectors such as the exemption from tax of the return to owner-occupied housing.

IV. Empirical Estimates of the Incidence of Capital Taxes

Two different policies are simulated, a reduction in the corporate income tax rate and a reduction in the personal tax rate on capital income. In both cases attention is focused on the change in the real return to capital and the change in the capital stock. The former change is related to traditional measures of tax incidence, while the latter is of interest in assessing the effectiveness of capital tax incentives in increasing capital formation.

A. Effects of a Reduction in the Corporate Income Tax

In Table 1 (following page 33) the effects of a corporate income tax reduction which results in a <u>one percent</u> decrease in the cost of capital economy wide are reported for seven different

situations. Because corporate income is a much bigger part of total capital returns in the two traded goods sectors, the decrease in the corporate income tax has a differential effect across sectors, although this difference is not as great as is found in the more traditional formulation where a corporate and a noncorporate sector are used. In the projections reported here, the percentage change in the cost of capital is 1.363 in the two traded goods sectors, and 0.774 in the nontraded goods sector. Therefore, the estimated results reflect the incidence of a general tax on capital income, as well as the differential effect across sectors.

A few polar cases motivated by the analysis of Harberger (1983) provide useful points of comparison in assessing the simulation results to be reported. First, consider the case where production of all goods requires only two factors, labor and capital, and where capital is completely immobile internationally and no net saving occurs. The imposition of a general tax on capital in all sectors of the economy will yield the familiar result that capital bears 100 percent of the tax burden; that is, the reduction in capital income will exactly equal the tax paid on capital income.

If, instead, the tax on capital income applies only to the two traded goods and not to the nontraded goods, and if the country faces fixed commodity prices internationally, then the loss

to capital can exceed the amount of the tax revenue collected. The reason for this outcome is that, unless the two traded goods have exactly the same factor requirements, the zero profit condition will determine a unique relationship between traded goods prices and gross factor costs (Samuelson 1953). The after-tax return to capital therefore falls by the per unit tax on capital. The lower return also is earned on capital utilized in the nontraded sector. Consequently, total capital income will decline by more than the increase in taxes paid by capital in the traded goods sector.

Finally, if perfect mobility of capital internationally is assumed, and the country is too small to affect returns to capital, the pattern of incidence essentially is reversed. The tax will cause capital to flow out of the country until the initial return is restored. Since prices are fixed in the traded goods sector, the zero profit conditions require that real wages decline. Consequently, labor loses from the imposition of a tax on capital. If there were no nontraded sector, the loss to labor would equal the amount of tax revenue collected from capital, since production costs must fall by that amount for U.S. producers to continue to sell at given international prices. The existence of a nontraded sector would mean that labor employed there also loses from reduced wages, and labor income would fall by more than the amount of capital taxes collected.

These conclusions are particularly strong because of the small country assumption with respect to commodity prices and capital returns, as well as the simplified two factor production structure. The patterns of incidence suggested by these simple cases can be observed in the polar cases in the simulation results derived from the more general model developed here. Tax incidence is measured as the change in the after-tax return to capital divided by the change in corporate and personal tax on capital income per unit of capital. On the first line of Table 1, the incidence measure TI1 is calculated with respect to capital used in the United States, while the measure reported on the second line, TI2, is in terms of capital owned by U.S. residents. On lines three through six of the table, percentage changes in the real return to capital are reported, since they are the relevant determinants of international capital flows. Also, percentage changes in the U.S. capital stock and in savings behavior are shown.

One polar case is shown in column one, represented by the assumption of a fixed capital stock and no international capital mobility. The tax incidence estimate is 1.004, which indicates that capital owners receive almost exactly all of the benefit from the corporate tax reduction. This result is similar to the closed economy estimates of Harberger, although the current

figures apply to a situation where international trade in goods is possible. The possibility of incidence much greater than 100 percent suggested in the polar case above is not realized. This is so, in part, because the United States is a sufficiently large country in international commodity markets, and its goods differ from those produced elsewhere, so that it does not face fixed prices. For the United States, a decrease in corporate taxes will reduce costs in the traded goods sector more than in the non-traded sector. Prices of traded goods will fall in world markets, and there will be a shift in demand away from non-traded goods. This decreases the gross return to capital relative to labor. Also, since production requires three factor inputs, and there is a low degree of substitutability between capital and skilled labor, some of the burden of the corporate income tax is shifted to skilled labor.

The second column shows the case where the capital stock is no longer fixed. Saving is possible and is assumed to increase when the real return to capital rises. Capital remains immobile internationally, though. In this situation a much smaller share of the benefit from a corporate tax reduction accrues to capital, only 25 percent. The result differs from column one since the U.S. capital stock grows and the greater availability of capital drives down its relative return, a result similar to what Ballentine observed.

The next four columns of Table 1 represent cases where international capital flows are incorporated into the model. The polar case is represented by the figures in column seven, where there is near perfect capital mobility internationally and where saving again is sensitive to the after tax rate of return. The estimates show that the estimated incidence measure is only .055, and consequently labor receives most of the benefit from the corporate tax reduction. The effect on capital would be even smaller if the United States were smaller relative to the rest of the world.

The contrasting pattern of incidence in columns one and seven results from changing two initial conditions, the assumptions of no international capital mobility and no saving. In terms of the relative importance of these two factors, the substitutability between U.S. and foreign assets possible with international capital flows dominates the general interest sensitivity of saving. In other words, the primary reason S_A^A rises is the reallocation of savings away from B assets to A assets.

The figures reported in columns three, four and five demonstrate that the importance of capital flows does not disappear even when the assumed degree of asset substitution is reduced substantially, and set equal to the value attributed to the sub-

stitutability of U.S. versus foreign goods, or even lower. The net inflow of capital from abroad is smaller and the benefit to U.S. capital owners is larger than when capital is highly mobile. The reallocation of A's savings away from B assets to A assets still continues to be the dominant reason that S_A^A is positive.

Key implications of this analysis are that even with moderate values of the potential substitutability between foreign and domestic assets, capital bears little of the burden of the corporate income tax. This is true even when there is no interest sensitivity of savings. Additionally, a corporate tax cut will lead to an increase in the stock of capital available in the United States. The source of this increase should not be regarded simply as foreign controlled investment. Rather, U.S. investors reduce their foreign investment and instead invest at home. Foreigners do increase their investment in the United States, and in fact, S_A^B appears much larger in percentage terms than S_A^A. However, given the much larger base from which S_A^A is measured, even in the most extreme case of near perfect international capital mobility, roughly 60 percent of the additional funds invested in the United States are provided by U.S. savers.

B. Effects of a Reduction in Personal Taxes on Capital Income

In Table 2 the effects of a reduction in the personal income tax on capital earnings are reported for the same seven situations shown in Table 1. The simulations assume that the reduction in personal taxes reduces the cost of capital by one percent for a given after-tax return. Again, the sectoral effects on capital costs are not uniform, and in fact are remarkably similar to the values reported for the corporate tax cut. Here, the cost of capital declines 1.363 percent in the two traded goods sectors and 0.808 percent in the non-traded sector. The decline in the cost of capital is greater for the traded goods sectors, because in those industries a larger share of capital income is distributed and subject to taxation at the personal level. In column one, the case of an economy with a fixed capital stock and no international capital mobility is shown. The incidence estimate differs slightly from the case of the corporate tax reduction, because the cost of capital impacts are distributed somewhat differently across the three sectors.

Figures in column two again represent the case where saving is possible and assumed to be interest sensitive, but no international capital mobility is allowed. The benefit to capital owners is reduced substantially as the capital stock grows. That

the results from these two cases are so similar in Tables 1 and 2 confirms the conventional view that in a situation of long run equilibrium for a closed economy, it makes little difference whether capital incentives are provided at the corporate or personal level.

Once international capital mobility is introduced, the similarity between the personal and corporate tax reductions vanishes. The extreme case of near perfect capital mobility combined with interest sensitive savings is shown in column seven. The gain to U.S. capitalists is 1.88 times the loss in tax revenue. The fact that capital may bear more than 100 percent of the burden of a tax on capital income has been suggested in several other situations, but the principal reason it is observed here will be shown to rest on the different taxation of the returns to domestic and foreign investors, and the correspondingly different portfolios they hold. Also in this case, as in some of the others, a decline in the U.S. capital stock is observed. In other words, the personal tax cut results in a large transfer to U.S. capital owners, but funds available for investment in the United States decline.

To explain this result, consider the two different sources of investment in the United States. U.S. investors increase their holdings of U.S. assets, as shown by the positive value obtained for S_A^A but the increase is much smaller than in the zero mobility case. Furthermore foreigners choose to invest substantially less in the United States, as shown by the large negative value of S_A^B.

This foreign investment response occurs even when i_A^A rises substantially, because the foreign investor is interested in i_A^B and not i_A^A. In particular, foreigners are not assumed to invest in the same mix of assets as U.S. investors, but rather to concentrate their investment where the difference is greatest between the after tax return at the personal level relative to the corporate level. Even though the average return received by U.S. investors rises by more than the tax benefit provided, the after tax return to foreign investors falls because they do not hold an initial portfolio with the same mix of assets as U.S. savers. The return to capital at the corporate level declines in the traded goods sectors where foreign investment is concentrated, because of the reallocation of capital to those industries. The cut in the U.S. personal tax rate results in a bigger disincentive for foreigners than would be the case if their optimal strategy were to hold the same assets as domestic investors. The loss to foreign investors explains why the two incidence measures reported in Table 2 differ. Foreign-owned capital used in the United States loses as a result of the U.S. tax cut at the personal level, and consequently the weighted average effect on all capital used in the United States is less favorable than for U.S.-owned capital.

The explanation of incentives faced by foreigners investing in the United States is mirrored by the incentives Americans face in investing abroad. As shown in column seven, the percentage increase of S_B^A is twelve times greater than S_A^A, which reflects the fact that the increase in i_B^A exceeds the increase in i_A^A. This change in relative returns, which is more dramatic in the lower mobility cases, is partially attributable to the relative size of the two countries as explained above, where a given increment of investment will cause returns abroad to fall less rapidly than in the United States. Additionally, U.S. investment abroad will be concentrated in industries where foreign taxation at the personal level is high, in contrast to domestic investment which includes a significant component not taxed at the personal level. U.S. investors in these foreign industries with smaller amounts of tax exempt income will benefit most from the U.S. personal tax cut, further contributing to an outflow of capital from the United States.

With respect to the effects of this outflow of capital from the United States, the smaller the United States is relative to the rest of the world, the smaller the consequent reduction in returns abroad. The fact that i_B^B declines by 0.248 percent when a U.S. tax reduction increases domestic after-tax returns by one percent (for a given pre-tax return) shows that U.S. policies do

have a significant effect on world capital markets. Capital invested in the United States is estimated to represent 25 percent of the free world total, a figure large enough for foreigners to benefit from an increase in U.S. taxation of capital at the personal level, or to lose from a U.S. tax reduction.

While an increase in the relative size of the United States tends to reduce the capital outflow from the United States, factor intensity differences in production tend to increase it. The personal tax cut increases the demand for capital most in the traded goods sectors, which require relatively less capital than the nontraded sector. Thus, the increase in the U.S. return to capital is smaller than it would be in the case of a neutral incentive across all sectors.

Columns three, four and five show that these issues are relevant even when a much smaller degree of international mobility is assumed. When the elasticity of substitution between U.S. and foreign assets is assigned a value of one, the U.S. capital stock rises by roughly half of the value obtained in a model with no international capital mobility. In other words, even with a very small degree of capital mobility internationally, the effectiveness of U.S. policies to spur capital formation through reductions in capital taxes at the personal level will be weakened substantially.

Also worth noting is that with greater capital mobility, the domestic after-tax rates of return, $\hat{i}_A^A$ and $\hat{i}_B^B$, tend to diverge further rather than equalize when there is a change in personal taxes in the United States. The reasons for the divergence is the different personal taxes born by foreign and domestic investors on the same investment return. For example, a cut in U.S. personal taxes will increase U.S. after-tax returns to domestic investors but will lower them to foreign investors because they receive no tax benefit from the U.S. personal tax cut and pre-tax returns decline in the United States. The resulting repatriation of capital then depresses after-tax returns abroad.

V. Conclusions

The results indicate that it takes much less than perfect capital mobility for international capital flows to substantially alter the impact of a domestic tax cut found in a standard model of a closed economy. Even with modest capital mobility, international shifts in capital will account for a significant part of the increase in capital employed in the United States when corporate U.S. taxes are cut. This shift also means that U.S. after-tax returns to capital rise only slightly, and that labor receives most of the benefits of the tax reduction.

In the case of a reduction in personal taxes on capital income, the potential benefits of larger domestic capital accumulation are greatly eroded by international capital mobility. U.S. savers are the primary beneficiaries of this tax reduction, but because of sectoral differences in personal taxation, they find that average after-tax returns increase more abroad than in the United States. For similar reasons, foreign savers find that their average after-tax returns fall less abroad than in the United States. As a result of these incentives, capital available in the United States may even decline.

Table 1
Projected Effects of a Reduction
in the Corporate Income Tax
(Scaled to a one-percent change in the cost of capital)

Variable	σ=0.0 η=0.0	σ=0.0 η=0.4	σ=1.0 η=0.4	σ=3.0 η=0.0	σ=3.0 η=0.4	σ=300 η=0.0	σ=300 η=0.4
TI1	1.004*	.254	.240	.261	.147	.139	.055
TI2			.190	.223	.122	.139	.055
$\hat{i}_A^A$	.857	.327	.267	.286	.174	.164	.070
$\hat{i}_B^A$			.015	.132	.040	.162	.068
$\hat{i}_A^B$			.267	.286	.174	.164	.070
$\hat{i}_B^B$	.000	.000	.015	.132	.040	.162	.068
$\hat{K}_A$		.171	.189	.183	.221	.225	.256
$\hat{S}_A^A$		.171	.176	.142	.190	.175	.205
$\hat{S}_B^A$			-.095	-.340	-.231	-.409	-.383
$\hat{S}_A^B$			.276	.466	.428	.562	.600
$\hat{S}_B^B$		.000	-.004	-.016	.073	-.016	.011

* In this case, capital is assumed to be fixed in real terms.

Table 2
Projected Effects of a Reduction
in Personal Taxes on Capital Income
(Scaled to a one-percent change in the cost of capital)

Variable	σ=0.0 η=0.0	σ=0.0 η=0.4	σ=1.0 η=0.4	σ=3.0 η=0.0	σ=3.0 η=0.4	σ=300 η=0.0	σ=300 η=0.4
TI1	1.074*	.267	.480	1.878	.875	2.199	1.582
TI2			.814	2.239	1.196	2.577	1.879
$\hat{i}^A_A$	.885	.337	.618	1.170	.845	1.237	1.101
$\hat{i}^A_B$			1.234	1.255	1.174	1.238	1.105
$\hat{i}^B_A$			-.735	-.183	-.508	-.116	-.252
$\hat{i}^B_B$	.000	.000	-.119	-.098	-.179	-.115	-.248
$\hat{K}_A$		.177	.093	-.101	.014	-.125	-.076
$\hat{S}^A_A$		.177	.206	-.078	.171	-.096	.132
$\hat{S}^A_B$			.845	.203	1.186	.246	1.571
$\hat{S}^B_A$			-.678	-.263	-1.060	-.321	-1.492
$\hat{S}^B_B$		.000	-.039	.018	-.046	.021	-.053

* In this case, capital is assumed to be fixed in real terms.

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APPENDIX A
The Model in Differential Form

The impact of changes in tax policy is computed by first casting the model in terms of percentage changes. The basic equations in the model have been described in the body of the paper. This appendix will present how some of the key equations appear in the model in differential form.

(a) Zero Profit Equations

Equation (1) above is the zero profit or price equation for industry X_{1A}. The differential form of equation (1) is:

$$\theta^A_{L1}\,\hat{w}_A + \theta^A_{H1}\,\hat{q}_A + \theta^A_{K1}\,\hat{r}_A = \hat{P}_{1A} - \theta^A_{K1}\,(\hat{t}^A_{c1} + \hat{t}^A_{p1}) \qquad \text{(A1)}$$

where θ_{ij} is the share of the value of output of good j attributable to factor i in country k. The use of a circumflex signifies the percentage change in a variable, although in the case of the tax variables it denotes $dt_i/(1-t_i)$.

(b) Factor Demand Equations

Equation (2) gives the input-output relation between commodity output and the demand for unskilled labor in country A. In differential form this equation is:

$$\lambda^A_{L1}\ \hat{X}_{1A} + \lambda^A_{L2}\ \hat{X}_{2A} + \lambda^A_{LN}\ \hat{X}_{NA}$$

$$-(\lambda^A_{L1}\ \theta^A_{H1}\ \sigma^{A1}_{LH} + \lambda^A_{L2}\ \theta^A_{H2}\ \sigma^{A2}_{LH} + \lambda^A_{LN}\ \theta^A_{HN}\ \sigma^{AN}_{LH})\ (\hat{w}_A - \hat{q}_A)$$

$$-(\lambda^A_{L1}\ \theta^A_{K1}\ \sigma^{A1}_{LK} + \lambda^A_{L2}\ \theta^A_{K2}\ \sigma^{A2}_{LK} + \lambda^A_{LN}\ \theta^A_{KN}\ \sigma^{AN}_{LK})\ (\hat{w}_A - \hat{r}_A)$$

$$= \hat{L}_A - \lambda^A_{L1}\ \theta^A_{K1}\ \sigma^{A1}_{K1}\ (\hat{t}^A_{c1} + \hat{t}^A_{p1}) - \lambda^A_{L2}\ \theta^A_{K2}\ \sigma^{A2}_{KL}\ (\hat{t}^A_{c2} + \hat{t}^A_{p2})$$

$$- \lambda^A_{LN}\ \theta^A_{KN}\ \sigma^{AN}_{KL}\ (\hat{t}^A_{cN} + \hat{t}^A_{pN}) \qquad \text{(A2)}$$

where λ^k_{ij} is the share of the total stock of factor i used in the production of good j in country k and σ^{km}_{ij} is the partial elasticity of substitution between factors i and j in the production of good m in country k. In this form, the impact of the tax changes on factor demand is explicit.

(c) Commodity Demand

A typical product demand equation in percentage change form, using good X in country A, D_{1A}, is:

$$\hat{D}_{1A} = EA1A1A\ \hat{P}_{1A} + EA1A1B\ \hat{P}_{1B} + EA1A2A\ \hat{P}_{2A} + EA1A2B\ \hat{P}_{2B}$$

$$+ EAYA\ \left(\frac{Y_A}{Y_A - S^A_B + S^B_A}\ \hat{Y}_A - \frac{S^A_B}{Y_A - S^A_B + S^B_A}\ \hat{S}^A_B + \frac{S^B_A}{Y_A - S_B + S^B_A}\ \hat{S}^B_A\right)$$

(A3)

where the coefficients represent the elasticity of demand in Country A for X_{1A} with respect to a change in the corresponding price shown.

(d) Savings Functions

The saving equations parallel to equations (4) and (5) for S_A^A and S_B^A are

$$\hat{S}_A^A = EAAA\ \hat{i}_A^A + EAAB\ \hat{i}_B^A + EAYA\ \hat{Y}_A \tag{A4}$$

$$\hat{S}_B^A = EAAA\ \hat{i}_A^A + EABB\ \hat{i}_B^A + EAYA\ \hat{Y}_A \tag{A5}$$

where EAAA and EAAB are the own and cross price elasticities of demand by A residents for assets in A and B. There are two parallel equations for saving by residents of B.

APPENDIX B
Derivation of Elasticities and Cross Elasticities for Commodity and Asset Demand Functions

The own and cross price elasticities in the differential form of the commodity demand equations are based on the Armington assumptons described in the text. For example, the own and cross elasticities of demand for X_{1A} sold in Country A will be

$$N_{1A,1A} = (1-S_{1A})\ \sigma_1 + S_{1A}N_1 \tag{B1}$$

$$N_{1A,1B} = ((1-S_{1A})\ (\sigma_1 - N_1) \tag{B2}$$

where S_{1A} is the share of the budget spent on X_1 which is allocated to S_{1A}, σ_1 is the elasticity of substitution between X_{1A} and X_{1B}, and N_1 is the elasticity of demand for the aggregate commodity X_1.

The savings elasticities are computed in a manner analogous to the commodity demand elasticities. Given the Armington separability assumption for foreign and domestic assets within the overall savings branch,

$$EAAA = (1-d)\ \sigma^A + d\eta^A \tag{B3}$$

$$EAAB = -(1-d)\ (\sigma^A - \eta^A) \tag{B4}$$

where d is the share of saving by A resident allocated to A assets.

APPENDIX C

Investment in Human Capital

The highly simplified version of the process of investment in human capital used in this paper rests on two equations to determine h and st. One equation corresponds to the decision by an individual to increase his human capital. This choice will be dependent on the change in the ratio of the returns to human capital relative to unskilled labor, any change in the interest rate, and the rate at which greater amounts of training time become necessary to generate successive increments in h. A second equation shows how the share of the labor force in training depends upon the absolute growth rate of the labor force, and on the training process to generate h.

Both equations, then, depend on the same basic behavioral relationship, which gives the amount of training time, T, that an average individual entering the labor force has to undertake in order to attain a level of human capital h during his active career. We assume that this relationship has the form $T = h^{\varepsilon}$. The average individual will choose the amount of training time T which maximizes the present value of his lifetime earnings, which is

$$(w + qh) \int_{T}^{V} e^{-it} dt \qquad \text{(C1)}$$

where i is the real interest rate and V is the total length of a career, including training. Maximizing the present value of lifetime earnings yields the condition

$$q/i\ (e^{-iT} - e^{iV}) = (w+qh)\ e^{iT}\varepsilon h^{\varepsilon-1} \qquad \text{(C2)}$$

For given assumed initial values of q, i, w, h, V, and T, the corresponding ε can be computed. Given this ε, it is then possible to use the above optimizing condition to compute the percentage change in h resulting from a one-percent change in q, w, and i.

The relationship between the share of the labor force in training, st, and h can be derived from the training productivity relationship, $T = h^{\varepsilon}$. In the case of a stationary labor force with equal entry and exit, st is simply equal to T/V. If the labor force is growing, then st>T/V, because the recent entrants, who are the ones in training, represent a larger share of the total.

Some of the assumptions used in calculating the response parameters are that workers initially spend ten percent of a 40-year work life in training, that the labor force is growing at one percent annually, that roughly 12 percent of the labor force is in training, and, based on the labor value added decomposition described earlier, the ratio of skilled to unskilled wages is 1.46. Given these values, a one-percent change in the ratio of skilled to unskilled wages is projected to lead to an increase in h of .075 percent, while an increase in the interest rate of one percent causes a decline in h of .167 percent.