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8 The Domestic International Sales Corporation and Its Effects

John Mutti and Harry Grubert

8.1 Introduction and Overview

Legislation which allowed U.S. firms to create Domestic International Sales Corporations (DISCs) was enacted in 1971. Under its provisions the tax due on a portion of the export income attributable to a DISC could be deferred, and therefore the program represented a tax incentive to export. The way in which the tax incentive was tied to a reduction in the firm's corporate income tax liability also created an incentive to substitute capital for other factors of production. In 1976 and 1982 the tax benefits from DISC were scaled back by the U.S. Congress. Additionally, the program was criticized by the Europeans as a violation of the General Agreement on Tariffs and Trade (GATT). Nevertheless, DISC was still in place in 1982, its benefits were claimed on 70 percent of all U.S. exports, and a tax saving of roughly $1.5 billion was realized.

Export promotion policies often generate the greatest amount of public attention when the economy is in a business contraction or when the trade deficit is large. In this analysis, these conditions, which imply that disequilibria in labor markets or foreign exchange markets exist, are ignored. Instead, a longer-run general equilibrium approach is taken. In this framework, DISC still might result in a welfare improvement, even though the impact of the subsidy is to worsen the U.S. terms of trade. Such an improvement might occur because of second-best factors, such as

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the distorting effect of the current corporate income tax or the tax deferral provisions available with respect to income earned abroad by U.S. controlled foreign corporations. In fact, DISC was promoted on the basis that it would give U.S. firms a greater incentive to produce and export from the United States instead of serving foreign markets by locating abroad. A major focus of this paper is to determine the extent to which investment and production at home versus abroad is affected by incentives such as DISC.

In the static, general equilibrium model developed here, two countries are represented, the U.S. and the rest of the world. The model in part is made up of familiar elements, including:

(a) Commodity demand functions in each country describing the choice between imported goods, domestically produced competing goods, home nontraded goods, and exportables.

(b) Factor demand equations in each country in which the demand for each factor depends on the quantity of each good produced and on relative factor prices.

(c) Competitive price equations in which the price of each good is equated to total factor cost.

DISC enters into this framework in several ways. First, it reduces the relative price charged for U.S. exports because it lowers the tax component of export costs. In addition, DISC lowers the cost of capital in export production relative to the cost of other inputs because it lowers the tax only on the return to capital. This tends to increase the demand for capital in the United States. Finally DISC changes the level of real income, which affects U.S. product demands, because the export incentive has to be financed by either an increase in other taxes or lower government expenditures. In other words, the benefit to foreigners in terms of more favorable prices requires a reduction in expenditures by the United States.

This income effect alternatively can be related to the terms of trade change experienced by the United States. If foreigners are able to obtain U.S. goods more cheaply because less U.S. tax is collected on export earnings, the U.S. terms of trade worsen and real income falls. When greater U.S. export output drives up the relative price of exports, this partially offsets the direct tax cost of DISC. Equivalently, the terms of trade loss is reduced.

The model developed here has a few other special features. Production of all goods is assumed to require three factors of production—unskilled labor, skilled labor, and capital—in order that aspects of the controversy over the factor content of trade (see, for example, Baldwin 1971; Branson and Monoyios 1977) be included in the analysis. This situation contrasts to the simpler breakdown of labor and capital alone in two

earlier general equilibrium models by Goulder, Shoven, and Whalley (1981) and by Horst (1981) used to analyze international tax policy changes. Also, in the Horst model only a single good was produced abroad, while the Goulder model did not include foreign production, but rather foreign endowments of output. The present model, in which each country produces three goods, allows a more complete representation of the possibilities to reallocate resources across industries in the rest of the world. Such a distinction particularly might be expected to influence the allocation of capital internationally (Jones 1967; Gerking and Mutti 1981).

The effects of DISC on international capital allocation are important in this study for two reasons. First, the potential reduction in U.S. income resulting from the terms of trade loss may be offset if DISC results in more capital being used in the United States, where it will be subject to U.S. rather than foreign taxation. Second, the reallocation of capital may significantly affect the distributional impacts of DISC. The allocation of capital internationally is assumed to depend on relative after-tax rates of return in the United States and the rest of the world. DISC provides an incentive to use more capital in U.S. export production, but U.S. produced capital goods also become cheaper abroad. To include these various and potentially offsetting effects, two alternative treatments of international capital mobility are formulated. A key question addressed is the extent to which after-tax returns across countries or across sectors are equalized. In one formulation of the model, after-tax returns are equalized across sectors within a country, and varying degrees of capital mobility are assumed internationally. This framework, which assumes a very high degree of integration of capital markets domestically, is similar to the work of Goulder et al. and of Horst. An alternative formulation treats the closest substitute for investment in a particular industry not as investment in another sector of the home market, but rather as investment in the same industry abroad. This treatment reflects the perspective of past writings on the operations of multinational corporations by Caves (1971) and Batra and Ramachandran (1980), based on the view that multinational corporations may earn higher than normal returns to specific expertise applicable in their industry alone.

As in previous work, the model is complex enough that analytical solutions do not yield unambiguous signs, and determination of the direction and magnitude of changes in output, prices, and factor rewards must be based on a particular set of parameter values. Empirical projections from these two frameworks are made on the basis of data from the operation of DISCs in 1979. These data provide a useful indication of the relative effects of DISC on outputs and factor rewards, although the absolute size of these changes would be expected to decline if provisions

of the 1981 Economic Recovery Tax Act (ERTA) result in sharply reduced corporate tax burdens and a correspondingly smaller differential incentive to export as a result of DISC.

With respect to the two models developed, the simulated results are somewhat similar when a high degree of capital mobility is assumed internationally, but as capital becomes less mobile, substantial differences between them arise. Of particular interest from a policy perspective, the percentage change in the volume of merchandise exports (about 3 percent if all exports were covered by DISC) is roughly 65 percent of the estimate that would be obtained using the same trade elasticities in a partial equilibrium framework. Unskilled labor clearly loses from DISC, while skilled labor benefits if capital can easily be reallocated internationally. From the standpoint of economic efficiency, DISC results in a deterioration of the U.S. terms of trade. The stock of capital used in the United States increases slightly, but the gains from this reallocation are not great enough to offset the terms of trade loss. U.S. welfare falls by roughly half of the tax cost of DISC.

The organization of this paper first is to explain the incentives created by DISC for a single firm. Then the general equilibrium model of the United States and the rest of the world is presented. The major purpose of this model is to show how DISC affects the allocation of resources both nationally and internationally. Values of the appropriate behavioral demand and production parameters are discussed next, followed by the projected changes in outputs and factor rewards attributable to DISC. Consequent welfare effects of DISC on the United States are analyzed, and a concluding section notes other relevant issues for any policy assessment of DISC.

8.2 The Analysis of DISC at the Micro Level

8.2.1 Background and History

Domestic International Sales Corporations, through which exporters can defer (indefinitely) the tax on part of the corporate income earned on exports, were first authorized by the Revenue Act of 1971. There are two basic steps in calculating the portion of export profits that can be tax deferred. The first determines the amount of overall export profits that can be allocated to the DISC, and the second, the percentage of the DISC's income whose taxation can be deferred.

In the first step, a DISC can have profits which do not exceed the greater of:

(1) 4 percent of the gross value of qualified export sales plus 10 percent of related export promotion expenses;
(2) 50 percent of the combined taxable income from exports of the DISC and its parent plus 10 percent of export promotion expenses;

(3) income based on the price actually charged the DISC by the supplier if it can be justified under the normal "arm's-length" rules.

The first two options are departures from normal arm's-length transfer pricing rules and are an important source of DISC benefits. The third pricing or allocation option would ordinarily only be chosen by independent DISCs who export goods purchased from third parties. A corporation producing export goods would choose option (2), the 50 percent rule, if its profit margin were in excess of 8 percent of sales, because it could then defer more income than under the 4 percent rule. If, on the other hand, margins are less than 8 percent of sales, it would choose the 4 percent rule. In fact, DISC exports are split about equally between those using the 4 percent of gross sales rule and those using the 50 percent of combined taxable income rule. However, the 50-50 rule accounts for about 80 percent of the total corporate profits deferred through DISCs. In terms of the capital used in exports, therefore, the 50-50 rule is by far the most significant.

Turning now to the portion of DISC income that can be deferred, a DISC is itself tax-exempt, but its shareholders are taxed on actual or imputed dividends from the DISC. In the original legislation in 1971, a DISC was assumed to distribute 50 percent of its income, whether it actually distributed this large a share of income to the parent or not. This meant that an exporter using the 50-50 rule could defer 25 percent of the overall combined taxable profits from exports. The Tax Reform Act of 1976 limited the 50 percent deferral to DISC profits attributable to exports in excess of 67 percent of average exports in a four-year base period, the last year of which is four years prior to the current tax year. As a result of the incremental rule, the average deferral rate in 1979 was 32.3 percent instead of the earlier 50 percent. In view of the amount of income allocated to the DISC, 18.3 percent of the combined export profits of the DISC and its parent was deferred. DISC therefore represents an 18.3 percent reduction in the corporate tax on export income. This will be regarded simply as a reduction in the tax *rate* on capital income, even though for the small share of benefits derived by users of the 4 percent of sales rule, DISC is more of an ad valorem subsidy on exports unrelated to factor usage. The Tax Equity and Fiscal Responsibility Act of 1982 further reduced DISC benefits by reducing the deferral permitted under previous law by 15 percent, that is, the 50 percent deferral rate now is 42.5 percent.

8.2.2 Economic Incentives Created by DISC

DISC changes the relative cost of exports by lowering the cost of equity capital used in export production relative to the cost of capital elsewhere in the economy. The cost of capital services to a firm reflects the price of the capital good involved in production, the after-tax return that has to be

given to investors for them to supply their capital, and any tax liability that results from the capital return. For a given after-tax return at the corporate level, capital must produce a gross return sufficient both to pay investors this after-tax return and to pay the required taxes to the government.

Consider the simple case in which there is only equity capital, that is, no debt, and real capital does not depreciate. (See appendix A for further elaboration.) Assume the price of capital goods used in production is c. Then, for a given required after-tax return of i percent per year, and a tax on the equity return to capital of t, the annual marginal product of capital, m, must be such that $m(1 - t) = ci$. In other words, the annual rental cost of capital input is $ci/(1 - t)$ (Hall and Jorgenson 1967). If the capital tax rate on exports falls from t to t_1, then for the given after-tax return, the marginal cost of capital declines to $(1 - t)/(1 - t_1)$ of its former level. With perfect competition in exports, which is assumed in the paper, export prices fall by the amount of the decline in the marginal cost of output. DISC therefore reduces the price of exports relative to other goods in the same way that a lower payroll tax in a particular activity would lower the activity's price relative to other goods. Workers would be willing to work for a lower gross wage, which is the cost to the employer, because they can get the same after-tax income as in other activities.

DISC also affects factor input usage, because it reduces the extent to which equity capital is discouraged relative to other inputs. Again, taking the case where all capital is financed by equity, and therefore not a deductible cost of doing business, the ratio of the marginal productivities of capital and labor is $ci/[(1 - t)w]$, where w is the wage rate, equal to the marginal productivity of labor. When DISC reduces the corporate tax rate faced, there is an incentive to substitute capital for labor.

8.2.3 The Interaction of DISC and Other Tax Incentives

Looking at the way DISC interacts with other tax incentives, such as the investment tax credit and accelerated depreciation, may help illustrate the way DISC works. The interaction with investment tax credits and depreciation allowances differs. An increased investment tax credit, such as the present 10 percent credit for most equipment, has a limited effect on the *relative* incentive effect of DISC, that is, the cost of exports relative to other goods. An exporter can still continue to enjoy the same DISC benefits and in addition use the additional investment tax credit for any remaining tax liability. On the other hand, increased depreciation allowances, as in ERTA, do erode the DISC benefit. As indicated above, most capital in exports uses the 50-50 pricing rule for DISC income. The amount of tax deferral that can be provided by a DISC therefore depends

on the amount of overall *taxable* income on the export sale. Increased depreciation allowances reduce taxable income, which means that the tax saving per dollar of export sales is reduced. In the extreme case where depreciation allowances eliminate taxable income, DISC provides no benefit.

Increased depreciation allowances may also erode the DISC benefits to those using the 4 percent of gross sales rule, because the allocation of income to the DISC cannot result in a loss to the parent. Increased depreciation allowances, as in the Accelerated Cost Recovery System in 1981, will reduce the DISC benefit if they reduce overall *taxable* profit margins below 4 percent.

The interaction between DISC and other tax incentives is clear from the standard Hall-Jorgenson cost of capital formula,

$$\frac{c(1-k-tZ)}{(1-t)}(i+\delta),$$

where t is the corporate tax rate, k is the rate of the investment tax credit, i is the required real percentage after-tax return, δ is the annual rate of economic depreciation, and Z is the present value of depreciation allowances (evaluated using the nominal return). DISC is effectively a reduction in the tax rate t. The formula demonstrates that the effect on the cost of capital of a reduction in the tax rate is diluted by an increase in Z, the value of depreciation deductions.

The significance of the effect of the Accelerated Cost Recovery System (ACRS) in ERTA on the incentive effect of DISC can be seen from the changes in the revenue cost of DISC resulting from the enactment of ACRS. The U.S. Treasury Department (1981) estimates that by 1984 the revenue costs of DISC will be 18 percent lower because of ACRS.

8.3 DISC in a General Equilibrium Model

An overview of the general equilibrium approach taken in this study was given in the introduction. Here two different models are developed to be used in evaluating DISC.

8.3.1 The Case of Homogeneous Capital

In this model, two countries are assumed. Each country produces three goods. Also, each country has fixed supplies of unskilled and skilled labor, which are immobile internationally but which can be shifted costlessly across industries within a country. Total capital available in the world is fixed. Within a country capital is perfectly mobile among industries, but internationally capital mobility is not sufficient to equalize after-tax returns. This result with respect to international capital flows is

somewhat similar to the framework proposed by Kemp and Wan (1974), where international adjustment costs are assumed to exist but the adjustment process also is not modeled explicitly.

In each country perfectly competitive output and factor markets are assumed. Given strictly quasi-concave, linear, homogeneous production functions, full employment of all factors of production is ensured. In country A this condition is represented as

$$C^A_{L1} X_{1A} + C^A_{L2} X_{2A} + C^A_{LN} X_{NA} = L_A, \tag{1}$$

$$C^A_{S1} X_{1A} + C^A_{S2} X_{2A} + C^A_{SN} X_{NA} = S_A, \tag{2}$$

$$C^A_{K1} X_{1A} + C^A_{K2} X_{2A} + C^A_{KN} X_{NA} = K_A, \tag{3}$$

where C^k_{ij} is the amount of input i necessary to produce one unit of output j in country k, X_{iA} represents output of the ith good in country A, and the factor supplies of unskilled labor, skilled labor, and capital are denoted by L_A, S_A, and K_A, respectively. As shown in appendix B, DISC incentives affect the determination of input-output coefficients in industries one and two, and any change in DISC alters optimal factor proportions.

The three aggregate production sectors of the economy represent a composite of industries for which the country is a net importer, X_{1A}, a composite of industries for which the country is a net exporter, X_{2A}, and a nontraded sector, X_{NA}. This characterization of three separate industries is somewhat similar to the trade literature testing the factor content of trade, where regression models are estimated to predict whether an industry is a net exporter or a net importer based on certain industry characteristics. In both that situation and in the present model, factor input requirements are assumed to differ across industries.

However, the definition of a net import or net export industry may suggest another condition not imposed on this analysis. Domestic output in an industry is not assumed to be perfectly substitutable with output from the same industry in the other country. Thus, three similar full-employment equations can be written for country B as follows:

$$C^B_{L1} X_{1B} + C^B_{L2} X_{2B} + C^B_{LN} X_{NB} = L_B, \tag{4}$$

$$C^B_{S1} X_{1B} + C^B_{S2} X_{2B} + C^B_{SN} X_{NB} = S_B, \tag{5}$$

$$C^B_{K1} X_{1B} + C^B_{K2} X_{2B} + C^B_{KN} X_{NB} = K_B, \tag{6}$$

but X_{iA} and X_{iB} are not identical products. Additionally, the assumption that the available supply of capital in the world is fixed, $K_A + K_B = \bar{K}$, allows equation (6) to be rewritten in terms of K_A.

Perfectly competitive output markets, together with the earlier production assumptions, guarantee that producers earn zero profits in equilibrium, so that

$$C^A_{L1}\, w_A + C^A_{S1}\, q_A + C^A_{K1}\, r_A/(1 - t_{1A}) = P_{1A}, \tag{7}$$

$$C^A_{L2}\, w_A + C^A_{S2}\, q_A + C^A_{K2}\, r_A/(1 - t_{2A}) = P_{2A}, \tag{8}$$

$$C^A_{LN}\, w_A + C^A_{SN}\, q_A + C^A_{KN}\, r_A/(1 - t_{NA}) = P_{NA} = 1, \tag{9}$$

$$C^B_{L1}\, w_B + C^B_{S1}\, q_B + C^B_{K1}\, r_B/(1 - t_{1B}) = P_{1B}, \tag{10}$$

$$C^B_{L2}\, w_B + C^B_{S2}\, q_B + C^B_{K2}\, r_B/(1 - t_{2B}) = P_{2B}, \tag{11}$$

$$C^B_{LN}\, w_B + C^B_{SN}\, q_B + C^B_{KN}\, r_B/(1 - t_{NB}) = P_{NB}, \tag{12}$$

where w_i is the wage paid to unskilled labor in country i, q_i is the wage paid to skilled labor in country i, r_i is the after-tax return to capital paid in country i, and t_{ij} is an ad valorem tax levied on capital income in industry i of country j. Also, P_{ij} is the price of X_{ij} received by the producer. Again, because goods produced in the same industry but in different countries are not assumed to be identical, five relative price terms must be included, with the price of the nontraded good in A being the numéraire. Since capital is perfectly mobile within a country, the same after-tax return to capital is earned in all industries, but clearly the before-tax returns will differ when tax rates across industries differ.

Consumers in each country choose among five different goods, X_{1A}, X_{2A}, X_{1B}, X_{2B}, and the relevant nontraded good, X_{NA} or X_{NB}. That is, country A exports some of its net import goods and country B exports some of its net import goods. Quantities demanded will depend on income and the relative prices of these goods, inclusive of any tariffs. Because this formulation is quite standard, the relevant equations are presented in appendix B, which shows the way DISC affects import prices seen by foreigners. One aspect which does deserve special attention is the relevant income expression, which depends on four types of terms: (1) the value of production within a country; (2) net earnings from foreign investment after payment of foreign taxes; (3) tariff revenues; and (4) the value of subsidies paid to foreigners through DISC export promotion.

$$\begin{aligned} Y_A = {} & P_{1A}X_{1A} + P_{2A}X_{2A} + X_{NA} + r_B(\tilde{K}_A - K_A) \\ & + \mathrm{TAR}_{1A}P_{1BA}X_{1BA} + \mathrm{TAR}_{2A}P_{2BA}X_{2BA} \\ & - \mathrm{DISCP} \cdot P_{1A}X_{1AB} - \mathrm{DISCP} \cdot P_{2A}X_{2AB}. \end{aligned} \tag{13}$$

$$\begin{aligned} Y_B = {} & P_{1B}X_{1B} + P_{2B}X_{2B} + P_{NB}X_{NB} + r_B(\tilde{K}_B - K_B) \\ & + \mathrm{TAR}_{1B}P_{1AB}X_{1AB} + \mathrm{TAR}_{2B}P_{2AB}X_{2AB}. \end{aligned} \tag{14}$$

Y_i is the value of nominal income in country i. $\tilde{K}_i$ indicates country i's ownership of capital, while K_i is the amount of worldwide capital used in country i. The amount of capital used in a country can change in response to economic incentives. When capital is reallocated from country A to

country B, then K_A declines and K_B increases. The United States is a net creditor to the rest of the world, so that $(\bar{K}_A - K_A) > 0$, while the rest of the world is a net debtor, where $(\bar{K}_B - K_B) = -(\bar{K}_A - K_A) < 0$. TAR_{ij} represents ad valorem tariff rates levied in country j on imports of i goods, P_{ijk} are the prices charged to consumers in country k for good i produced in country j, and the X_{ijk} are interpreted similarly in the case of sales. The DISCP terms represent the cost to the United States of the tax benefit offered to exporters. It is the difference between the tax exporters would have paid without DISC and their tax payments inclusive of DISC benefits. The additional tax that exporters would pay without DISC reflects *both* the higher tax rate *and* the higher pretax income that would have to be earned to end up with the same after-tax income.

To more fully understand the representation of capital in this model, recognize that the production functions are based on a flow of capital services. The income equations also include terms that represent payments to foreigners for a flow of capital services. However, the capital services available in a country will be proportional to the stock of capital located in it, and this stock will change when the location of capital internationally shifts. The relocation of capital represents a stock adjustment which could be written in terms of the actual capital stocks. To simplify notation, though, separate terms are not introduced to represent them. Rather, because available capital stocks always are assumed to be proportional to the physical flows of capital services (e.g., machine hours per year), both the stock of capital in country i and the flow of capital services available in country i are assumed to be represented by K_i.

It is assumed that capital goods in A are identical to those in B. However, they are not transported physically from one country to another. Therefore, any capital reallocation implicitly is based on the situation where capital depreciates in the country losing capital, while new capital is produced in the country gaining it. In each country, capital is assumed to be manufactured from the five available goods in the same proportions as consumers demand them. Capital goods are therefore equivalent to the average consumption good in each country. Actual depreciation rates and gross investment decisions are not included in the model, which gives net outputs and the new reallocation of capital.

The new equilibrium allocation of the world capital stock depends on relative after-tax rates of return and is represented by

$$\frac{K_A}{\bar{K}} = g_0 \left[\frac{r_A}{\text{CPI}_A} \Big/ \frac{r_B}{\text{CPI}_B} \right]^{g_1} \tag{15}$$

The CPI terms represent a price index for each country. The rate of return in a country depends on the value of the marginal product of physical capital, r, and its price of capital, CPI. Because DISC results in lower prices of capital goods abroad, CPI_B, the percentage rate of return

abroad does not fall in the same proportion as the fall in the value of the marginal product of capital abroad, r_B. Ignoring this price of capital effect would result in a larger projected shift of capital into the United States than would actually occur. The model would yield the same results if it were expressed in terms of the percentage rate of return, i, and the cost of capital goods, c, presented earlier in the Hall-Jorgenson framework.

Of the ten demand equations referred to above, only nine are considered explicitly in order to set quantity demanded equal to quantity supplied in five markets and thereby close the model. Thus, this model consists of twenty-seven equations (six full-employment equations, six zero-profit equations, nine commodity-demand equations, one international capital flow equation, and five market balance equations) to determine changes in six industry outputs, six factor rewards, nine quantities demanded, five relative prices, and the flow of capital internationally. All equations are expressed in percentage rates of change, as shown in appendix B, which is the form in which the model is applied to predict percentage changes in outputs, factor rewards, and capital flows as a result of DISC. This method of analysis differs from the approach of Goulder et al., which works from *levels* of outputs and factor rewards to predict final levels of these variables. The changes in these variables predicted here would be expected to give a close approximation to any solution based on the more general technique of Goulder et al., since the effects of DISC are quite small in relation to the U.S. economy. Thus, any interaction terms ignored in the process of differentiating the model should be insignificant.

8.3.2 The Case of Industry-Specific Capital

The alternative case of industry-specific capital requires no modification of the demand side of the model. With respect to supply conditions, if the capital currently employed in each industry is regarded as specific to that industry, then in each country three full-employment equations for the three categories of capital replace the single previous equation. Thus, equation (3) is replaced by

$$C_{K1}^{A} X_{1A} = K_{1A}, \tag{16}$$

$$C_{K2}^{A} X_{2A} = K_{2A}, \tag{17}$$

$$C_{KN}^{A} X_{NA} = K_{NA}; \tag{18}$$

and equation (6) becomes

$$C_{K1}^{B} X_{1B} = K_{1B}, \tag{19}$$

$$C_{K2}^{B} X_{2B} = K_{2B}, \tag{20}$$

$$C_{KN}^{B} X_{NB} = K_{NB}. \tag{21}$$

Allowing for industry-specific capital means that six different returns to capital must be determined. Therefore, the zero-profit equations (7) to (12) must be rewritten in terms of these separate variables.

Also, the reallocation of capital no longer is summarized in terms of perfect mobility domestically and some degree of mobility internationally. Rather, if capital employed in a single sector is to expand, it must be attracted from other sectors, but in no case is this transfer costless. An example of the framework considered is as follows:

$$K_{1A} = g_{1A0}\left[\frac{r_{1A}}{\mathrm{CPI}_A}\Big/\frac{r_{1B}}{\mathrm{CPI}_B}\right]^{g_{1A1B}}\cdot\left[\frac{r_{1A}}{r_{2A}}\right]^{g_{1A2A}} \cdot\left[\frac{r_{1A}}{r_{NA}}\right]^{g_{1ANA}}\cdot\left[\frac{r_{1A}}{\mathrm{CPI}_A}\Big/\frac{r_{2B}}{\mathrm{CPI}_B}\right]^{g_{1A2B}} \cdot\left[\frac{r_{1A}}{\mathrm{CPI}_A}\Big/\frac{r_{NB}}{\mathrm{CPI}_B}\right]^{g_{1ANB}}. \tag{22}$$

Capital is assumed to be more mobile from one country to another in the same industry than it is between different industries in the same country, because owners of capital have specialized knowledge about their present industry. Thus, g_{1A2A} is assumed to be smaller than g_{1A1B}, for example. Costs of transferring capital from outside the industry and outside the country are assumed to be even higher, so that g_{1ANB} is smaller than g_{1A2A}. Also, since

$$\frac{\partial K_{1A}}{\partial(r_{1A}/r_{2A})} = \frac{-\partial K_{2A}}{\partial(r_{1A}/r_{2A})}, \tag{23}$$

for example, the values of the g_{ij} across the different capital-flow equations are not independent. Similar equations are introduced for K_{2A}, K_{NA}, K_{1B}, and K_{2B}.

The four additional capital-flow equations plus the four additional full-employment conditions represent the modifications to be included in the model with industry-specific capital. This thirty-five equation system determines changes attributable to DISC in six industry outputs, ten factor rewards, nine commodity demands, five relative output prices, and five capital flows. Again, the differentiated form of the complete model is presented in appendix B.

8.4 Empirical Implementation of the Model

As stated in the introduction, few unambiguous results can be deduced a priori in this model, and any conclusions drawn will depend on the set of parameter values considered to be most appropriate. The three aggregate goods were created on the basis of industry information reported in the

1972, eighty-five-sector, input-output table of the United States. Nontraded goods and services, X_{NA}, basically were considered to be utilities, construction, transportation and communication, wholesale and retail trade, social and personal services, finance, banking and real estate, and government. Net export goods, X_{2A}, where an export surplus was reported in 1972, essentially were grains, chemicals, and machinery. Net import goods, X_{1A}, where imports exceeded exports in 1972, included many consumer durables and nondurables.

Factor intensities of production are based on the value-added figures from the input-output table. Direct and indirect capital and labor requirements for each of the three aggregate sectors are calculated from the direct value-added shares and the matrix of direct and indirect intermediate input requirements reported at the eighty-five-sector level. These data alone only allow the breakdown of factor requirements to distinguish between capital and labor, and therefore additional information is necessary to decompose the labor requirements into skilled and unskilled components. The basis for that distinction is information on industry employment made available by Professor Robert Baldwin. This employment figure 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 implicit in the full-employment equations.

With respect to general statements characterizing U.S. industry, the nontraded 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. These findings are roughly consistent with studies of the factor content of trade (Branson and Monoyios 1977; Bowen 1980) concerning the skill intensity of exports versus imports. However, much larger factor requirement differences exist between both tradable sectors and the nontradable sector.

Partial elasticities of substitution between capital and unskilled labor, unskilled labor and skilled labor, and capital and skilled labor do not appear to be well established. A survey piece on this subject by Hamermesh and Grant (1980) indicates that most studies deal only with the breakdown of production workers versus nonproduction workers, which cannot be easily related to differential amounts of human capital in each category of workers. Grant's dissertation (1979) provides estimates based on data where years of educational attainment could be distinguished, although his survey work notes the possible downward bias of cross-

sectional estimates relative to those based on time series. His figures are adapted to give the following set of figures applied to all industries in the study: $\sigma_{KL} = \sigma_{LS} = .60$, 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:

$$U_A = U_A[(X_{1A}, X_{1B})\ (X_{2A}, X_{2B}), X_{NA}]. \tag{24}$$

$$U_B = U_B[(X_{1A}, X_{1B}), (X_{2A}, X_{2B}), X_{NB}]. \tag{25}$$

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. For example, the own and cross-price elasticities of demand for X_{1A} sold in country A will be

$$N_{1A,1A} = (1 - S_{1A})\ \sigma_1 + S_{1A} N_1, \tag{26}$$

$$N_{1A,1B} = (1 - S_{1A})\ (\sigma_1 - N_1), \tag{27}$$

where S_{1A} is the share of the budget spent on X_1 which is allocated to X_{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. To form a consistent aggregate such as X_1 requires that the income elasticity of demand for X_{1A} and X_{1B} be identical, and in this study all income elasticities are set equal to 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 United States 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.

Information regarding flows of capital internationally is quite limited, as is information with respect to the initial division of capital across countries. Bowen (1980) estimates that in 1975 the United States accounted for roughly one-third of the world's capital stock. The mobility of capital internationally represents one of the weakest links empirically in the present model, and therefore different values of capital responsiveness are simulated to test the sensitivity of the results to the somewhat arbitrary assignment of values.

Although the general degree of capital mobility is varied in simulations for both specifications of the model, in the case of industry-specific capital a single set of values is used to represent differences in the cost of reallocating capital from one sector to another. Capital flowing across

countries in the same traded good industry is assumed to be twice as responsive to rate of return differentials as capital flowing from other industries in the same country, and ten times as responsive as capital flowing from other industries in the opposite country. For example, from equation (23) the following relationship among coefficients holds: $g_{1A1B} = 2g_{1A2A} = 10g_{1ANB}$.

To estimate the direct effect of DISC on export prices, start with the tax saving per dollar of export sales, which was .94 percent in 1979. If DISC were eliminated and exporters increased their prices to maintain after-tax returns, their *taxable* income would increase. For example, if they increased prices by 1 percent, their after-tax income would only go up by .54 percent of sales and tax liability by .46 percent, with a 46 percent tax rate. Therefore, to regain the full .94 percent loss in tax benefits, exporters would have to raise their prices by .94/.54 or 1.74 percent. This is the estimated DISC impact on export prices.

DISC resulted in a reduction in the cost of capital in export production of 11.4 percent in 1979. We assume that the change in the marginal cost of capital is equal to the change in the average cost. The marginal cost is not estimated directly because of the difficulty in implementing the Hall-Jorgenson formula on a comprehensive scale. The estimate of the change in the average cost of capital is based in part on the various components of the net cost of capital in the corporate sector computed by Ballard, Fullerton, Shoven, and Whalley (1982). These include the after-tax corporate profits, federal and local corporate income taxes, property taxes, and interest paid. A federal corporate tax rate is computed after adding back investment tax credits to corporate liabilities because, as noted above, DISC represents an approximately 18.3 percent reduction in corporate taxes *before* credits. This 18.3 percent reduction in taxes is used to compute a new post-DISC level of corporate taxes, holding the amount of after-tax profits constant. This is then used to compute a new aggregate cost of capital which reflects the lower tax attributable to DISC. The incentive to substitute capital for labor in the production of X_{1A} and X_{2A} depends on this cost reduction and the share of industry output which is exported. Because the share of X_{2A} output which is exported is five times greater than the share of X_{1A} output which is exported, DISC has a much greater effect on factor proportions in X_{2A} than in X_{1A} production.

The estimated effects of DISC on the cost of capital and on export prices are based on the *average* tax saving by exporters per dollar of sales and investment income. One reason why the marginal incentive may differ from the average in this context is the incremental provisions introduced in 1976. For an additional dollar worth of exports, the DISC would in 1979 obtain a full deferral rate of 50 percent, but there would be some loss in later years because the base for computing incremental

exports in future years increases. It turns out that in 1979 the marginal deferral rate would have been equal to the average observed rate if firms used a 12 percent discount rate.

The estimated effects of DISC on prices and on the cost of capital assume that any deferral of tax through the use of a DISC is the equivalent to the exemption of tax, that is, the deferral can be indefinite. The retained earnings of a DISC have to be invested in certain specified "qualified" export assets, but this limitation does not seem to be significant. This is suggested by the fact that *actual* dividends by DISCs to their parents in 1979 were only 73 percent of the distributions assumed under the DISC rules. Furthermore, total DISC assets grew much faster than they would have simply from retained earnings. All of this means that DISCs could profitably use assets substantially in excess of those they had to hold to prevent the taxation of previously deferred income.

8.5 Empirical Results: A Positive Analysis

Projected changes in output and the allocation of capital internationally are reported in table 8.1. The corresponding changes in factor rewards and output prices are reported in table 8.2. For each of the two different model specifications (homogeneous versus industry-specific capital), three sets of values are reported to demonstrate how sensitive the results of the model are to the extent of capital mobility internationally. The polar case of no international capital mobility, $g = 0$, is included to demonstrate what limiting values will be reached as mobility declines.

Table 8.1 **Projected Impacts on Output and Capital Utilization from DISC (all figures represent percentage changes)**

Variable	Case of Homogeneous Capital			Case of Industry-Specific Capital		
	$g = 100$	$g = 1$	$g = 0$	$g = 100$	$g = 1$	$g = 0$
X_{1A}	−.067	−.069	−.078	−.068	−.011	.401
X_{2A}	.802	.800	.791	.800	.447	−.326
X_{NA}	−.063	−.064	−.068	−.062	−.036	−.150
X_{1B}	.091	.092	.097	.091	.072	.031
X_{2B}	−.057	−.056	−.052	−.056	−.014	.052
X_{NB}	−.038	−.037	−.036	−.038	−.030	−.015
K_A	.038	.031	.000	—	—	—
K_{1A}	.042	.036	.010	.038	−.056	.000
K_{2A}	1.256	1.252	1.227	1.250	.908	.000
K_{NA}	−.085	−.092	−.126	−.083	−.049	.000
K_{1B}	—	—	—	.085	.063	.000
K_{2B}	—	—	—	−.061	−.022	.000

Table 8.2 **Projected Impacts on Prices and Factor Rewards from DISC (all figures represent percentage changes)**

Variable	Case of Homogeneous Capital			Case of Industry-Specific Capital		
	$g = 100$	$g = 1$	$g = 0$	$g = 100$	$g = 1$	$g = 0$
wA	−.099	−.101	−.110	−.098	−.065	−.221
qA	.100	.092	.054	.099	.079	−.175
rA	.003	.024	.130	—	—	—
$r1A$	—	—	—	.003	−.003	−.804
$r2A$	—	—	—	.018	1.138	3.547
rNA	—	—	—	.001	−.028	.888
wB	−.661	−.664	−.680	−.661	−.620	−.802
qB	−.607	−.620	−.614	−.611	−.576	−.778
rB	−.611	−.612	−.686	—	—	—
$r1B$	—	—	—	−.607	−.543	−.574
$r2B$	—	—	—	−.607	−.548	−.372
rNB	—	—	—	−.608	−.610	−.861
$P1A$	.045	.045	.043	.045	.037	−.327
$P2A$	.054	.052	.046	.056	.271	.558
$P1B$	−.633	−.636	−.655	−.633	−.589	−.754
$P2B$	−.634	−.637	−.654	−.634	−.592	−.721
PNB	−.601	−.604	−.623	−.601	−.572	−.765
CPIA	−.022	−.023	−.025	−.022	−.010	−.084
CPIB	−.635	−.638	−.656	−.635	−.599	−.781

Projections obtained from parameter values greater than $g = 100$ are not very different from those reported, and consequently the values obtained at $g = 100$ represent an alternative extreme.

8.5.1 The Case of Homogeneous Capital

The outcome from the model based on homogeneous national capital will be discussed first. In the case of the United States, output of the net export good, X_{2A}, rises, while output of the net import good and the nontraded good both fall. The decline in output in the nontraded sector is not surprising, since the DISC incentives draw resources into export production and out of other sectors of the economy. X_{1A} output declines as a consequence of the balance-of-payments constraint imposed. If the value of U.S. exports rises, then the rest of the world must export more to the United States, a result that is achieved by a fall in the price of country B's output relative to country A's domestic prices. The net import sector is most affected by this reaction, and its output falls. The greatest increase in X_{2A} output occurs when capital is most mobile internationally, since additional resources can be attracted without driving up input costs as much. The greatest declines in X_{1A} and X_{NA} output occur when capital is least mobile, since the greater incentive to substitute capital for other

factors of production in X_{2A} output now can be satisfied only by attracting it out of the other domestic sectors, X_{1A} and X_{NA}.

Within country B, output of X_{1B} rises while output of the other two composite goods falls. When capital is not as mobile internationally, domestic output in country B does not fall as much, since more capital is available to use in production within the country. The reallocation of capital to the United States occurs because U.S. after-tax returns rise. This result cannot be guaranteed a priori, since expansion of U.S. export production may require other factors more intensively than capital and thereby offset the factor price incentive which increases demand for capital. However, that situation does not arise given the relevant set of parameter values in each economy.

The impact effect of the DISC incentive represents a reduction of .46 percent in the U.S. economy-wide gross capital return required to maintain given after-tax returns, but even in the case where near-perfect capital mobility is assumed, the U.S. capital stock increased by only .038 percent. This capital reallocation is not as large as Horst (1981) projects. Possible explanations for this difference are the attention paid to real versus nominal capital returns in the United States and abroad, and the allowance for more than one producing sector in the rest of the world. When foreign capital prices fall relative to U.S. prices, then less new investment is likely to be made in the United States in comparison with the case of constant foreign prices. When more than one producing sector exists in the foreign economy, the elasticity of the foreign demand for capital schedule is likely to increase. The fact that the U.S. capital stock increases only slightly does not mean that capital mobility is unimportant, though, because changes in income distribution depend quite strongly on it.

Wages of unskilled labor are most adversely affected by DISC. Because the export sector requires little unskilled labor, that labor can remain fully employed only by accepting a large cut in wages. Skilled labor is used intensively in the export sector, and when capital is highly mobile internationally, this factor gains the most in relative terms from DISC. However, as capital mobility declines internationally, so does the benefit to skilled labor from DISC. A smaller capital inflow into country A means a smaller increase in demand for output from A producers, or equivalently, less demand for the fixed factors, unskilled labor and skilled labor. While returns to unskilled labor fall for this reason, the effect on skilled labor is even more pronounced because of the extremely low elasticity of substitution between skilled labor and capital. When demand for skilled labor falls, a large decline in its relative price is necessary to maintain full employment. Finally, a related result implied above is that returns to capital rise, and this increase is greatest when U.S. capitalists

need not contend with the reallocation of capital from the rest of the world.

Prices of U.S. traded goods rise slightly, but the U.S. terms of trade still fall by approximately two-thirds of the initial DISC price effect. That is, the price of imported foreign goods falls by roughly one-third of the 1.74 percent DISC price effect. The U.S. output shift toward traded goods forces a similar change in the rest of the world, as the nontraded sector declines in both countries.

8.5.2 The Case of Industry-Specific Capital

When the capital is industry specific, but nevertheless highly mobile internationally, projected effects of DISC are very similar to those already described: U.S. output of net exports, X_{2A}, rises at the expense of X_{1A} and X_{NA}, while foreign output of net exports, X_{1B}, rises and output of X_{2B} and X_{NB} falls; capital is reallocated toward X_{2A} production from elsewhere in the U.S. economy and from abroad; wages of unskilled labor fall, and skilled labor gains.

As capital mobility declines, capital initially in X_{2A} becomes the specific factor most likely to benefit from increased demand for X_{2A} or from the incentive to use K_{2A} rather than other inputs. In the polar case where $g = 0$, capital is immobile both internationally and across sectors within each economy. In that situation any resource reallocation across sectors is limited to skilled and unskilled labor, a situation differing considerably from the case of $g = 0$ in the homogeneous capital model, where capital reallocation within the U.S. economy still was possible. Consequently, in the more restrictive situation depicted by the figures in the last column of tables 8.1 and 8.2, significant differences appear in comparison with any of the other results. Some of these projections appear counterintuitive. For example, why does DISC result in a decline in the output of X_{2A} but an increase in the output of X_{1A}? Exports of both goods still rise, but domestic demand for X_{2A} falls because of the relatively large increase in its prices. The contraction in the supply of X_{2A} seems best explained in terms of a Rybczinski-like effect. Contraction of output of X_{NA} results in the release of skilled and unskilled labor, but since the nontraded sector is highly intensive in unskilled labor, that factor is released in relatively greater amounts than skilled labor. The net import sector, X_{1A}, requires slightly more unskilled labor than the net export sector, X_{2A}. Therefore, the additional unskilled labor available would be absorbed by greater X_{1A} output and reduced X_{2A} output, with skilled labor being released from X_{2A} to use with the additional unskilled labor in X_{1A}. Perhaps this situation is of limited relevance in policy analysis, but if capital immobility is identified with shorter-run policy impacts, these short-run effects

suggest counterintuitive output incentives and a large windfall to owners of capital in the export sector.

An additional distinction that arises in the case of industry-specific capital is the relatively smaller terms of trade deterioration, but a larger decline in the value of foreign investment income. These somewhat offsetting effects still leave a decline in U.S. income and its consequent demand implications, which were explained above.

8.5.3 Comparison of Partial and General Equilibrium Analysis

One question of interest in a policy context has been the projected effect of DISC on U.S. exports and employment in those industries. The DISC report of the U.S. Treasury Department (1981) estimates the change in the value of U.S. exports on the basis of a partial equilibrium framework, where the label "partial equilibrium" is applied because of the lack of attention to balance-of-payments constraints. In other words, U.S. exports are assumed to increase, and the balance-of-payments position of foreign countries is allowed to worsen with no pressure for adjustments on their part. Such a situation would represent an equilibrium result only if the United States were willing to continually increase its lending to foreign borrowers irrespective of rates of return.

The general equilibrium model developed here projects an increase in exports of 3.1 percent. The increase in exports derived from a simple partial-equilibrium analysis for the same export demand elasticities assumed here would yield a 4.9 percent increase in exports. In contrast, a Marshall-Lerner type of analysis, which attempts to go one step further than the simple partial analysis by computing the appreciation of the dollar resulting from the initial "partial" expansion in exports and then recomputing the change in exports, results in an export expansion of 2.9 percent.

Why is the increase in exports in the general equilibrium model somewhat larger than in the standard Marshall-Lerner framework? One reason is that the initial loss in U.S. income associated with the DISC subsidy is not introduced into the usual Marshall-Lerner analysis. This loss in income results from the necessity to finance the DISC incentive, that is, lowering export prices cannot be costless to the United States. Because U.S. consumption is strongly oriented to U.S.-produced goods, a loss in U.S. income tends to create an excess supply of U.S. production, limiting the appreciation of the dollar necessary in the Marshall-Lerner analysis.

8.6 Normative Analysis of DISC

The welfare or economic efficiency effects of DISC must be evaluated in a second-best setting, where the existence of other distorting policies is

recognized. The focus of the present study on internationally mobile capital suggests an important set of distortions to include: the set of international taxes on capital income. A basic condition for DISC to improve world efficiency is fairly stringent—DISC must result in the reallocation of capital away from low-tax uses toward high-tax uses. This situation may arise if current foreign tax rates are lower than in the United States, since U.S. tax code provisions allow the income of U.S.-controlled foreign corporations to avoid U.S. taxation until the income is repatriated to the United States. If DISC causes U.S.-based multinational corporations (MNCs) to choose domestic over foreign locations, world efficiency may be enhanced because capital would move to where it has a higher pre-tax return, even inclusive of DISC benefits.

The main problem with this second-best argument is that the United States is not now, at the corporate level, a high-tax country. The Commerce Department benchmark survey, *U.S. Direct Investment Abroad, 1977*, indicates that in 1977 foreign manufacturing affiliates of U.S. companies paid an average income tax rate of 42.0 percent. The comparable U.S. rate, including federal, state, and local taxes, on their parents was 45.8 percent. In addition, the U.S. rate on new investment has been reduced substantially since 1977 because of ACRS and the other provisions of the Economic Recovery Tax Act of 1981 (ERTA), even after the cutbacks in 1982 are considered. For example, the effective tax rate on new investment in equipment in manufacturing as a whole is now about what it was before ERTA for equipment used in exports. To the extent that DISC draws capital from abroad, it will come, *on the average*, from countries in which the corporate tax rate is at least as high as in the United States.

Of course, from the standpoint of national welfare, the United States still can gain from the inflow of capital even when the world as a whole loses. Traditional analysis of international capital flows suggests some of the relevant factors to consider: the terms of trade loss to the United States from subsidizing exports may be offset by the gain to the United States as a net creditor to the rest of the world, if real returns to capital rise internationally as a result of DISC. Furthermore, since the United States collects little tax from U.S.-based multinational investments in high-tax countries, as a result of the foreign tax credit allowed up to the value of the U.S. tax liability, the United States will gain from the reallocation of capital into jurisdictions where U.S. rather than foreign taxes on capital are collected. Finally, if capital is reallocated within the U.S. economy from low-tax to high-tax sectors, a welfare gain will result.

As shown in appendix C, the change in U.S. potential welfare as a result of DISC can be approximated by the following expression:

$$
\begin{aligned}
(28) \qquad U^* = {} & \frac{P_{1A} X_{1AB}}{Y_A} \cdot P^*_{1A} + \frac{P_{2A} X_{2AB}}{Y_A} \cdot P^*_{2A} \\
& - \frac{P_{1B} D_{1BA}}{Y_A} \cdot P^*_{1B} - \frac{P_{2B} D_{2BA}}{Y_A} \cdot P^*_{2B} \\
& - \text{DISCREV} + \frac{r_A K_{1A}}{(1 - t_{1A}) Y_A} \cdot K^*_{1A} + \frac{r_A K_{2A}}{(1 - t_{2A})} \cdot K^*_{2A} \\
& + \frac{r_A K_{NA}}{(1 - t_{NA}) Y_A} \cdot K^*_{NA} - \frac{r_B K_A}{\text{CPI}_B Y_A} \cdot K_A \\
& + \frac{r_B (\tilde{K}_A - K_A)}{\text{CPI}_B Y_A} \cdot (r^*_B - \text{CPI}^*_B) \\
& + \frac{\text{TAR}_{1A} \cdot P_{1B} D_{1BA}}{Y_A} \cdot (P^*_{1B} + D^*_{1BA}) \\
& + \frac{\text{TAR}_{2A} \cdot P_{2B} D_{2BA}}{Y_A} \cdot (P^*_{2B} + D^*_{2BA}) .
\end{aligned}
$$

The first five terms represent the terms of trade effect attributable to DISC, which is expected to be negative since the loss in U.S. export receipts from the tax subsidy is not completely offset by cheaper imports. The next four terms represent the potential gain to the United States from the reallocation of capital both within the United States from low-tax to high-tax sectors and also from abroad. If there were no taxes levied at home or abroad, and capital could be moved across borders costlessly, these four terms would sum to zero. The r^*_B term shows the U.S. gain as a net creditor to the rest of the world if the real return to capital rises abroad, and the final two terms are the gain in U.S. tariff revenue collected if the value of imports rises.

This expression is evaluated for the three sets of simulated values reported from the model based on homogeneous capital. The corresponding expression for the case of industry-specific capital requires modifying the capital flow terms to include industry-specific rates of return and allowing for the U.S. net creditor position with respect to the three different types of capital used in country B. In all cases the United States experiences a welfare loss as a result of DISC. In the case of homogeneous capital this loss is smaller when capital mobility is larger, but in the case of heterogeneous capital just the opposite result holds. Assuming DISC applies to all U.S. exports, the estimated annual losses in the case of homogeneous capital are .037 percent of national income when capital is highly mobile ($g = 100$), .037 percent of income when capital is moderately mobile ($g = 1$), and .040 percent when capital is completely immobile ($g = 0$). For the case of heterogeneous capital, the

welfare loss estimates are .041, .039, and .030 percent of income for the three cases analyzed, as reported in descending order of capital mobility.

These net efficiency effects equal approximately half of the revenue cost of DISC, a percentage much higher than generally is obtained in the analysis of domestic tax policies. While the DISC-induced welfare loss appears small as a percentage of national income, in absolute value this estimate is more than three times the projected gain to the United States from a 50 percent pre–Tokyo Round multilateral tariff reduction (Baldwin, Mutti, and Richardson 1980). Furthermore, the tariff reduction policy results in an increase in exports nearly twice that of DISC. The primary reason that the DISC welfare effects are so large relative to the volume of trade affected is that DISC results in a substantial terms of trade loss to the United States, and reallocation of capital into the United States is not sufficient to offset that loss.

8.7 Qualifications

The results discussed above clearly are dependent on the parameter values chosen as well as the way each model is formulated. The theoretical framework and the empirical basis for the parameter values used were discussed previously, but additional points are raised here.

One possibility ignored is the incentive for greater capital formation from the increase in the after-tax return to capital. The greater the responsiveness of savings to this rate of return, the larger the increase in U.S. output which eventually will be realized, and the larger the tax base from which to make up the DISC revenue loss. Goulder, Shoven, and Whalley (1981) simulate such a scenario in five-year intervals, to illustrate the path of adjustment followed by the economy, while Horst (1981) considers the new steady-state solution and an intermediate position in which one-fifth of the eventual adjustments have been made. The projected effect of DISC on total savings is not unambiguous on a priori grounds. The higher real rate of return does give a price incentive for additional saving, but the loss in real income may reduce saving.

Also, the quantitative analysis in this paper has assumed that export markets are competitive. If the model were expanded to include noncompetitive behavior and added elements, such as variable advertising intensity, the results may differ in various ways. One change would involve the calculated reduction in the marginal cost of capital attributable to DISC. In the estimates described earlier, we assumed that all of the marginal after-tax return to capital in exports was made up of the competitive, required real rate of return. If, on the contrary, some of the return reflects monopoly rents, the decline in the *marginal* cost of capital because of DISC would be smaller than we have estimated it to be. The effect of DISC on export price and the increase in exports would there-

fore be somewhat overstated in our estimates, while the gain to monopoly producers at the expense of the other factor inputs would be ignored.

It is also conceivable that, if exporters have the opportunity to increase advertising and marketing efforts, the decline in export prices may be less than indicated in a simple model. The welfare loss because of the decline in the terms of trade may for that reason also be overstated, but with a somewhat larger, but not necessarily compensating, loss because of overinvestment in marketing. However, it is not clear why a decline in capital costs should lead to disproportionate increases in advertising. Furthermore, the statement by some market observers that DISC does not lower an exporter's prices may simply reflect the fact that export markets *are* competitive, and that a single exporter cannot affect market prices. In that case, the market supply shifts assumed in our model would be appropriate.

8.8 Related Policy Concerns

The main purpose of this paper has been to explain the incentives created by the DISC program and to project how they might alter the location of production internationally and the factor rewards in the United States and abroad. Several other policy aspects of the DISC program have not been addressed in this analysis, and these issues are discussed briefly to conclude the paper.

One issue not considered is the effect of alternative tax policies on production and factor rewards. If the United States were to adopt a corporate tax cut resulting in the same revenue loss as DISC, would returns to capital rise to a greater extent and attract a greater inflow of capital into the United States? Would the changes in income distribution be similar to those created by DISC? These questions of differential incidence actually were implicit in the 1978 tax proposals of the Carter administration. A similar framework in which to consider these trade-offs would be to impose a balanced budget constraint, and to consider any disincentives that would arise from tax increases necessary to make up for the tax expenditures on DISC. The present study does not obtain Horst's (1981) result that the DISC revenue loss is largely made up by additional taxes collected from the reallocated capital, primarily because he assumes a much larger differential in taxes on capital income across different sectors of the U.S. economy than the figures reported by Ballard, Fullerton, Shoven, and Whalley (1982).

Another issue that frequently arises is the relationship between the DISC provisions and border tax adjustments in the form of rebates on value-added and other "indirect" taxes on exports. It is sometimes claimed that DISC is simply the equivalent of these border tax adjustments and that the United States is at a disadvantage relative to its trading

partners in having a greater portion of its tax revenue in the form of "direct" taxes, such as the corporate income tax.

While the GATT distinction between rebates on direct and indirect taxes lacks a sound theoretical basis, previous analysis consistent with the model in this paper makes it clear that DISC is not the equivalent of border tax adjustments on indirect taxes (Johnson and Krauss 1970). The reason is that border tax adjustment practices involve not only a rebate of taxes on exports but also the imposition of the indirect tax (such as the value-added tax) on similar imports. This imposition of taxes on imports prevents the allocational and terms of trade effects that have been the subject of this paper. Resources do not flow out of import-competing goods because the tax on imports restores the relative competitiveness of domestically produced goods. The imposition of taxes on imports at the same time as the rebate on exports means that the terms of trade do not tend to fall for the exporting country, unlike the case of DISC, because *in real terms* the export supply schedule is not shifted in the same way. This is not to say that border tax adjustments as implemented by EEC countries are completely neutral. Because value-added taxes are typically of the consumption type, that is, they exempt capital goods, they are not uniform, and border tax adjustments do have an effect. However, they do not necessarily give any trade advantage to the countries using them.

A related observation is that if the main justification for DISC rests on its foreign trade impacts, rather than its ability to increase capital formation or to raise U.S. national income, then a complete analysis of DISC should compare it to alternative ways of meeting export goals. The other major U.S. export incentive program is the Export-Import Bank, which provides various kinds of credit-financing assistance to exporters. The Export-Import Bank would appear to have some advantages over DISC in terms of *relative* effectiveness. For one thing, it can target on exports whose demand is most elastic. Apart from any mercantilistic considerations, targeting on highly elastic demands may be beneficial in reducing the terms of trade loss that results from an export incentive. In some extreme cases, subsidizing the highly elastic exports may improve overall terms of trade. However, the first-best policy would be simply to impose taxes on the exports with lower elasticities.

Nevertheless, it is not entirely clear that the Export-Import Bank is successful in focusing on highly elastic imports, even though its procedures explicitly attempt to do so. The main problem is that, by its nature, the Export-Import Bank is limited to assisting large, durable equipment exports such as commercial aircraft and electrical generating equipment. It can offer few benefits to the wide range of industrial materials, such as chemicals and semiconductors, whose demand may be highly elastic. The limited scope of the Export-Import Bank can be seen from the fact that all Export-Import Bank programs, including credit guarantees and insur-

ance, assisted $18.1 billion of exports in fiscal year 1980. The comparable figure for DISC exports is above $130 billion, including almost $100 billion of manufactured exports.

The Export-Import Bank may have one advantage in that it may be an effective threat against foreign subsidies. Its financing can be targeted to exports competing against products receiving subsidies from other governments, and it can be withdrawn when foreign subsidies are eliminated. But, here again, the Export-Import Bank's scope is relatively narrow because it is directed only against foreign *credit* subsidies and not the whole range of foreign intervention.

Finally, Export-Import Bank programs have an effect on capital flows which differs from DISC and is undesirable from the U.S. point of view. In contrast to DISC, which lowers the cost of capital in the U.S. export sector, the Export-Import Bank's primary effect is to lower the cost of capital to foreign users of U.S.-made equipment. Export-Import Bank programs would be expected to cause a capital outflow from the United States.

In addition to these economic issues, there is the significant legal issue regarding the consistency of DISC with U.S. obligations to the GATT. In July 1972, soon after the enactment of the DISC legislation, the European Economic Community (EEC) filed a complaint in GATT that the DISC provisions constituted an export subsidy under article XVI:4 of the General Agreement on Tariffs and Trade, which states that contracting parties shall cease to grant subsidies on the export of any product (other than a primary product) which results in the price of the export being lower than the comparable price in domestic markets. The remission or exemption of direct (income) taxes on exports was also specifically included in a 1960 GATT illustrative list of prohibited subsidy measures. After the EEC filed its complaint, the United States in turn filed complaints against Belgium, France, and the Netherlands on the grounds that their territorial tax systems, which exempt foreign income, resulted in export subsidies because the income of foreign sales affiliates in low-tax countries did not reflect arm's-length prices on sales from the parent.

In November 1976, the GATT panels which reviewed the DISC and related cases found that DISC as well as the challenged tax practices of the three EEC countries violated article XVI. In December 1981, the GATT Council, which is an assembly of all members, accepted the panel report subject to the qualification that: (a) economic processes located outside a country, including those involving exported goods, need not be taxed by the exporting country; (b) transactions between exporting enterprises and foreign buyers must adhere to arm's-length principles; and (c) article XVI:4 does not prohibit the adoption of measures to relieve double taxation of foreign-source income. The United States agreed to the adoption of the reports as modified by the qualifying statement but

did not accept the conclusion of the panel report that DISC was a violation of article XVI:4. It interpreted the qualifying statement as an exoneration of DISC.

Even though the United States refused to acknowledge that DISC violated the GATT, it recognized that the unresolved DISC issue greatly inhibited its ability to bring claims on other issues to the GATT. Therefore the United States announced at a GATT Council meeting in October 1982 that, while not conceding the issue, it would present a legislative proposal to the Congress which would address the concerns of its trading partners. However, as of the end of 1982, it was not clear whether these legislative proposals would involve the simple elimination of the DISC incentive or the transformation of DISC into some GATT legal form with the same tax benefits to exporters.

Appendix A

The following model demonstrates the incentives which DISC creates for a typical firm. The firm is assumed to maximize after-tax profits from its sales in the United States and abroad. Production can be sold domestically or in the export market, and deductible production costs are prorated on the basis of output shares in each market. The expression to maximize is:

$$\begin{aligned}\pounds = {} & (1 - t_{1A})\left[p_{1AA}X_{1AA} - \frac{X_{1AA}}{X_{1A}}(rBK + wL)\right] - r(1 - B)\,K \\ & + [1 - t_{1A}(1 - D)]\left[p_{1AB}X_{1AB} - \frac{X_{1AB}}{X_{1A}}(rBK + wL)\right] \\ & + \lambda[X_{1A}(K, L) - X_{1AA} - X_{1AB}],\end{aligned}$$

where p_{1AA} is the price charged for sales of X_{1A} in country A, X_{1AA} is the volume of sales of X_{1A} in country A, B is the share of capital financed by bonds or debt, r is the after-tax return to capital received by lenders, t_{1A} is the tax rate on corporate income, and D is the tax saving from DISC.

Differentiating this expression with respect to X_{1AA} and X_{1AB} yields two first-order conditions which can be set equal to each other and manipulated to give

$$\frac{p_{1AB}}{p_{1AA}} = \frac{(1 - t_{1A})}{1 - t_{1A}(1 - D)}\left[1 - \frac{rBK + wL}{p_{1AA}X_{1A}}\right] + \frac{rBK + wL}{p_{1AA}X_{1A}}.$$

Let $[(rBK + wL)/p_{1AA}X_{1A}]$ equal $\emptyset$, and recognize that $\emptyset$ is the share of receipts accounted for by deductible production costs. Correspondingly,

(1 − Ø) represents the return to equity capital as a share of sales. Therefore,

$$\frac{p_{1AB}}{p_{1AA}} = \frac{1 - t_{1A}}{1 - t_{1A}(1 - D)}[1 - Ø] + Ø,$$

which shows that if there is no return to equity capital, then Ø = 1 and DISC provides no incentive to charge a lower price in export markets. The smaller Ø is, the more significant DISC is in encouraging a price gap in favor of exports.

DISC also leads to an incentive to substitute capital for labor, since it reduces the penalty on equity capital because of the corporate income tax. Differentiating the profit expression with respect to K and L yields two first-order expressions from which the ratio of marginal productiveness can be formed:

$$\frac{\mathrm{MP}L}{\mathrm{MP}K} = \frac{(1 - t_{1A})\,\psi_{1AA}\,w + [1 - t_{1A}(1 - D)]\,\psi_{1AB}\,w}{(1 - t_{1A})\psi_{1AA}\,Br + rB + [1 - t_{1A}(1 - D)]\,\psi_{1AB}\,Br},$$

where ψ_{1AA} is the share of output sold in country A. This expression can be written in terms of percentage rates of change in a quite compact form if it is assumed that the initial position is one of no DISC incentive:

$$\hat{\mathrm{MP}}L - \hat{\mathrm{MP}}K = \hat{w} - \hat{r} + \frac{\psi_{1AB}(1 - B)t_{1A}}{(1 - t_{1A}B)(1 - t_{1A})}\,dD - \frac{(1 - B)}{(1 - t_{1A}B)}\,\frac{dt_{1A}}{1 - t_{1A}}.$$

The terms on the right-hand side demonstrate how tax policy changes alter the relative cost of using capital and labor.

Appendix B

In this appendix the two general equilibrium models are expressed in terms of percentage rates of change of all variables. The model based on homogeneous (H) capital nationally is presented first.

Full-Employment Equations

(H1) Unskilled labor in country A:

$$C^A_{L1}X_{1A} + C^A_{L2}X_{2A} + C^A_{LN}X_{NA} = L_A.$$
$$\lambda^A_{L1}X^*_{1A} + \lambda^A_{L2}X^*_{2A} + \lambda^A_{LN}X^*_{NA} - (\lambda^A_{L1}\theta^A_{S1}\sigma^{A1}_{LS} + \lambda^A_{L2}\theta^A_{S2}\sigma^{A2}_{LS} + \lambda^A_{LN}\theta^A_{SN}\sigma^{AN}_{LS})(w^*_A - q^*_A) - (\lambda^A_{L1}\theta^A_{K1}\sigma^{A1}_{LK} + \lambda^A_{L2}\theta^A_{K2}\sigma^{A2}_{LK} + \lambda^A_{LN}\theta^A_{KN}\sigma^{AN}_{LK})(w^*_A - r^*_A) = L^*_A + \lambda^A_{L1}\theta^A_{K1}\sigma^{A1}_{LK}\phi_{1AB}\mathrm{DISC1}A + \lambda^A_{L2}\theta^A_{K2}\sigma^{A2}_{LK}\phi_{2AB}\mathrm{DISC2}A.$$

Where λ_{ij}^{k} is the share of the total stock of factor i used in the production of good j in country k; θ_{ij}^{k} is the share of the value of output of good j attributable to factor i in country k; σ_{ij}^{km} is the partial elasticity of substitution between factors i and j in the production of good m in country k; and ϕ_{ijk} is the percentage of output of good i produced in country j which is sold in country k. DISC is the percentage reduction in the cost of capital used in the production of goods for export. The use of an asterisk signifies the percentage change in a variable.

(H2) Skilled labor in country A:

$$C_{S1}X_{1A} + C_{S2}X_{2A} + C_{SN}X_{NA} = S_A .$$
$$\lambda_{S1}^{A}X_{1A}^{*} + \lambda_{S2}^{A}X_{2A}^{*} + \lambda_{SN}^{A}X_{NA}^{*} - (\lambda_{S1}^{A}\theta_{L1}^{A}\sigma_{LS}^{A1} + \lambda_{S2}^{A}\theta_{L2}^{A}\sigma_{LS}^{A2}$$
$$+ \lambda_{SN}^{A}\theta_{LN}^{A}\sigma_{LS}^{AN})(q_A^{*} - w_A^{*}) - (\lambda_{S1}^{A}\theta_{K1}^{A}\sigma_{SK}^{A1} + \lambda_{S2}^{A}\theta_{K2}^{A}\sigma_{SK}^{A2}$$
$$+ \lambda_{SN}^{A}\theta_{KN}^{A}\sigma_{SK}^{AN})(q_A^{*} - r_A^{*}) = S_A^{*} + \lambda_{S1}^{A}\theta_{K1}^{A}\sigma_{KS}^{A1}\phi_{1AB}\mathrm{DISC1}A$$
$$+ \lambda_{S2}^{A}\theta_{K2}^{A}\sigma_{KS}^{A2}\phi_{2AB}\mathrm{DISC2}A .$$

(H3) Capital in country A:

$$C_{K1}^{A}X_{1A} + C_{K2}^{A}X_{2A} + C_{KN}^{A}X_{NA} = K_A .$$
$$\lambda_{K1}^{A}X_{1A}^{*} + \lambda_{K2}^{A}X_{2A}^{*} + \lambda_{KN}^{A}X_{NA}^{*} - (\lambda_{K1}^{A}\theta_{L1}^{A}\sigma_{LK}^{A1} + \lambda_{K2}^{A}\theta_{L2}^{A}\sigma_{LK}^{A2}$$
$$+ \lambda_{KN}^{A}\theta_{LN}^{A}\sigma_{LK}^{A})(r_A^{*} - w_A^{*}) - (\lambda_{K1}^{A}\theta_{S1}^{A}\sigma_{KS}^{A1} + \lambda_{K2}^{A}\theta_{S2}^{A}\sigma_{KS}^{A2}$$
$$+ \lambda_{KN}^{A}\theta_{SN}^{A}\sigma_{KS}^{AN})(r_A^{*} - q_A^{*}) = K_A^{*} - (\lambda_{K1}^{A}\theta_{L1}^{A}\sigma_{LK}^{A1}$$
$$+ \lambda_{K1}^{A}\theta_{S1}^{A}\sigma_{KS}^{A1})\phi_{1AB}\mathrm{DISC1}A - (\lambda_{K2}^{A}\theta_{L2}^{A}\sigma_{LK}^{A2}$$
$$+ \lambda_{K2}^{A}\theta_{S2}^{A}\sigma_{KS}^{A2})\phi_{2AB}\mathrm{DISC2}A .$$

(H4) Unskilled labor in country B:

$$C_{L1}^{B}X_{1B} + C_{L2}^{B}X_{2B} + C_{LN}^{B}X_{NB} = L_B .$$
$$\lambda_{L1}^{B}X_{1B}^{*} + \lambda_{L2}^{B}X_{2B}^{*} + \lambda_{LN}^{B}X_{NB}^{*} - (\lambda_{L1}^{B}\theta_{S1}^{B}\sigma_{LS}^{B1} + \lambda_{L2}^{B}\theta_{S2}^{B}\sigma_{LS}^{B2}$$
$$+ \lambda_{LN}^{B}\theta_{SN}^{B}\sigma_{LS}^{BN})(w_B^{*} - q_B^{*}) - (\lambda_{L1}^{B}\theta_{K1}^{B}\sigma_{LK}^{B1} + \lambda_{L2}^{B}\theta_{K2}^{B}\sigma_{LK}^{B2}$$
$$+ \lambda_{LN}^{B}\theta_{KN}^{B}\sigma_{LK}^{BN})(w_B^{*} - r_B^{*}) = L_B^{*} .$$

(H5) Skilled labor in country B:

$$C_{S1}^{B}X_{1B} + C_{S2}^{B}X_{2B} + C_{SN}^{B}X_{NB} = S_B .$$
$$\lambda_{S1}^{B}X_{1B}^{*} + \lambda_{S2}^{B}X_{2B}^{*} + \lambda_{SN}^{B}X_{NB} - (\lambda_{S1}^{B}\theta_{L1}^{B}\sigma_{LS}^{B1} + \lambda_{S2}^{B}\theta_{L2}^{B}\sigma_{LS}^{B2}$$
$$+ \lambda_{SN}^{B}\theta_{LN}^{B}\sigma_{LS}^{BN})(q_B^{*} - w_B^{*}) - (\lambda_{S1}^{B}\theta_{K1}^{B}\sigma_{KS}^{B1} + \lambda_{S2}^{B}\theta_{K2}^{B}\sigma_{KS}^{B2}$$
$$+ \lambda_{SN}^{B}\theta_{KN}^{B}\sigma_{KS}^{BN})(q_B^{*} - r_B^{*}) = S_B^{*} .$$

(H6) Capital in country B:

$$C^B_{K1}X_{1B} + C^B_{K2}X_{2B} + C^B_{KN}X_{NB} = K_B.$$
$$\lambda^B_{K1}X^*_{1B} + \lambda^B_{K2}X^*_{2B} + \lambda^B_{KN}X^*_{NB} - (\lambda^B_{K1}\theta^B_{L1}\sigma^{B1}_{LK} + \lambda^B_{K2}\theta^B_{L2}\sigma^{B2}_{LK} + \lambda^B_{KN}\theta^B_{LN}\sigma^{BN}_{LK})(r^*_B - w^*_B) - (\lambda^B_{K1}\theta^B_{S1}\sigma^{B1}_{KS} + \lambda^B_{K2}\theta^B_{S2}\sigma^{B2}_{KS} + \lambda^B_{KN}\theta^B_{SN}\sigma^{BN}_{KS})(r^*_B - q^*_B)$$
$$= K^*_B = -\frac{K_A}{K_B}K^*_A.$$

Zero-Profit Equations

(H7) Production of X_{1A} in country A:

$$C^A_{L1}w_A + C^A_{S1}q_A + C^A_{K1}r_A/(1 - t_{1A}) = P_{1A}.$$
$$\theta^A_{L1}w^*_A + \theta^A_{S1}q^*_A + \theta^A_{K1}r^*_A = P^*_{1A}.$$

(H8) Production of X_{2A} in country A:

$$C^A_{L2}w_A + C^A_{S2}q_A + C^A_{K2}r_A/(1 - t_{2A}) = P_{2A}.$$
$$\theta^A_{L2}w^*_A + \theta^A_{S2}q^*_A + \theta^A_{K2}r^*_A = P^*_{2A}.$$

(H9) Production of X_{NA} in country A:

$$C^A_{LN}w_A + C^A_{SN}q_A + C^A_{KN}r_A/(1 - t_{NA}) = P_{NA} = 1.$$
$$\theta^A_{LN}w^*_A + \theta^A_{SN}q^*_A + \theta^A_{KN}r^*_A = 0.$$

(H10) Production of X_{1B} in country B:

$$C^B_{L1}w_B + C^B_{S1}q_B + C^B_{K1}r_B = P_{1B}.$$
$$\theta^B_{L1}w^*_B + \theta^B_{S1}q^*_B + \theta^B_{K1}r^*_B = P^*_{1B}.$$

(H11) Production of X_{2B} in country B:

$$C^B_{L2}w_B + C^B_{S2}q_B + C^B_{K2}r_B = P_{2B}.$$
$$\theta^B_{L2}w^*_B + \theta^B_{S2}q^*_B + \theta^B_{K2}r^*_B = P^*_{2B}.$$

(H12) Production of X_{NB} in country B:

$$C^B_{LN}w_B + C^B_{SN}q_B + C^B_{KN}r_B = P_{NB}.$$
$$\theta^B_{LN}w^*_B + \theta^B_{SN}q^*_B + \theta^B_{KN}r^*_B = P^*_{NB}.$$

Demand Equations in country A

(H13) Demand for X_{1A} in country A:

$$D_{1AA} = f_1(P_{1A}, P_{1B}, P_{2A}, P_{2B}, Y_A).$$
$$D^*_{1AA} = E^A_{1A1A}P^*_{1A} + E^A_{1A1B}P^*_{1B} + E^A_{1A2A}P^*_{2A} + E^A_{1A2B}P^*_{2B} + E^A_{Y1A}Y^*_A.$$

(H14) Demand for X_{1B} in country A:

$$D_{1BA} = f_2(P_{1A}, P_{1B}, P_{2A}, P_{2B}, Y_A).$$
$$D^*_{1BA} = E^A_{1B1A} P^*_{1A} + E^A_{1B1B} P^*_{1B} + E^A_{1B2A} P^*_{2A} + E^A_{1B2B} P^*_{2B} + E^A_{Y1B} Y^*_A.$$

(H15) Demand for X_{2A} in country A:

$$D_{2AA} = f_3(P_{1A}, P_{1B}, P_{2A}, P_{2B}, Y_A).$$
$$D^*_{2AA} = E^A_{2A1A} P^*_{1A} + E^A_{2A1B} P^*_{1B} + E^A_{2A2A} P^*_{2A} + E^A_{2A2B} P^*_{2B} + E^A_{Y2A} Y^*_A.$$

(H16) Demand for X_{2B} in country A:

$$D_{2BA} = f_4(P_{1A}, P_{1B}, P_{2A}, P_{2B}, Y_A).$$
$$D^*_{2BA} = E^A_{2B1A} P^*_{1A} + E^A_{2B1B} P^*_{1B} + E^A_{2B2A} P^*_{2A} + E^A_{2B2B} P^*_{2B} + E^A_{Y2B} Y^*_A.$$

(H17) Demand for X_{NA} in country A:

$$D_{NA} = f_5(P_{1A}, P_{1B}, P_{2A}, P_{2B}, Y_A).$$
$$D^*_{NA} = E^A_{NA1A} P^*_{1A} + E^A_{NA1B} P^*_{1B} + E^A_{NA2A} P^*_{2A} + E^A_{NA2B} P^*_{2B} + E^A_{YNA} Y^*_A.$$

Where D_{ijk} represents the quantity of good i produced in country j that is demanded in country k; E^m_{ijkl} is the elasticity of demand of purchasers in country m for good i produced in country j with respect to a change in the price of good k produced in country l; and E^m_{yij} is the income elasticity of demand of purchasers in country m for good i produced in country j. The percentage change in income is:

$$Y^*_A = \Pi_{1A} P^*_{1A} + \Pi_{2A} P^*_{2A} + \frac{r_A K_{1A}}{(1 - t_{1A}) Y_A} K^*_{1A} + \frac{r_A K_{2A}}{(1 - t_{2A}) Y_A} K^*_{2A} + \frac{r_A K_{NA}}{(1 - t_{NA}) Y_A} K^*_{NA} - \frac{r_B K_A}{Y_A} K^*_A + \frac{r_B (\tilde{K}_A - K_A)}{Y_A} r^*_B + \text{TAR1}A\,(P^*_{1B} + D^*_{1BA}) + \text{TAR2}A\,(P^*_{2B} + D^*_{2BA}) - \text{DISC REV}.$$

Where Π_{iA} is the share of GNP accounted for by output of good i, TAR_{iA} represents the share of GNP in country A accounted for by tariff revenue collected from imports of good i, and DISC REV is the grossed up value of the tax saving to exporters due to DISC.

Demand Equations in country B

(H18) Demand for X_{1A} in country B:

$$D_{1AB} = g_1(P_{1A}, P_{1B}, P_{2A}, P_{2B}, P_{NB}, Y_B, \text{DISC}).$$
$$D^*_{1AB} = E^B_{1A1A} P^*_{1AB} + E^B_{1A1B} P^*_{1B} + E^B_{1A2A} P^*_{2AB} + E^B_{1A2B} P^*_{2B} + E^B_{1ANB} P^*_{NB} + E^B_{Y1A} Y^*_B.$$

(H19) Demand for X_{1B} in country B:

$$D_{1BB} = g_2(P_{1A}, P_{1B}, P_{2A}, P_{2B}, P_{NB}, Y_B, \text{DISC}).$$
$$D^*_{1BB} = E^B_{1B1A} P^*_{1AB} + E^B_{1B1B} P^*_{1B} + E^B_{1B2A} P^*_{2AB} + E^B_{1B2B} P^*_{2B} + E^B_{1BNB} P^*_{NB} + E^B_{Y1B} Y^*_B.$$

(H20) Demand for X_{2A} in country B:

$$D_{2AB} = g_3(P_{1A}, P_{1B}, P_{2A}, P_{2B}, P_{NB}, Y_B, \text{DISC}).$$
$$D^*_{2AB} = E^B_{2A1A} P^*_{1AB} + E^B_{2A1B} P^*_{1B} + E^B_{2A2A} P^*_{2AB} + E^B_{2A2B} P^*_{2B} + E^B_{2ANB} P^*_{NB} + E^B_{Y2A} Y^*_B.$$

(H21) Demand for X_{2B} in country B:

$$D_{2BB} = g_4(P_{1A}, P_{1B}, P_{2A}, P_{2B}, P_{NB}, Y_B, \text{DISC}).$$
$$D^*_{2BB} = E^B_{2B1A} P^*_{1AB} + E^B_{2B1B} P^*_{1B} + E^B_{2B2A} P^*_{2AB} + E^B_{2B2B} P^*_{2B} + E^B_{2BNB} P^*_{NB} + E^B_{Y2B} Y^*_B.$$

Where the change in income is

$$Y^*_B = \Pi_{1B}(P^*_{1B} + X^*_{1B}) + \Pi_{2B}(P^*_{2B} + X^*_{2B}) + \Pi_{NB}(P^*_{NB} + X^*_{NB}) + \text{TAR1}B(D^*_{1AB} + P^*_{1AB}) + \text{TAR2}B(D^*_{2AB} + P^*_{2AB}) + \frac{r_B(\tilde{K}_B - K_B)}{Y_B} r^*_B - \frac{r_B K_B}{Y_B} K^*_B.$$

Also, $P^*_{1AB} = P^*_{1A} - \text{DISC } P,$

and $P^*_{2AB} = P^*_{2A} - \text{DISC } P.$

Where DISC P is the price incentive explained in appendix A.

Capital-Flow Equation

(H22) $$K_A = g_0\left[\frac{r_A}{\text{CPI}_A} \Big/ \frac{r_B}{\text{CPI}_B}\right]^{g_1}.$$

$$K^*_A = g_1(r^*_A - \text{CPI}^*_A - r^*_B + \text{CPI}^*_B).$$

Market Equilibrium Conditions

(H23) $$X_{1A} = D_{1AB} + D_{1AA}.$$
$$X^*_{1A} = \phi_{1AB} D^*_{1AB} + \phi_{1AA} D^*_{1AA}.$$

(H24) $X_{2A} = D_{2AB} + D_{2AA}$.
$X^*_{2A} = \phi_{2AB} D^*_{2AB} + \phi_{2AA} D^*_{2AA}$.

(H25) $X_{NA} = D_{NA}$.
$X^*_{NA} = D^*_{NA}$.

(H26) $X_{1B} = D_{1BA} + D_{1BB}$.
$X^*_{1B} = \phi_{1BA} D^*_{1BA} + \phi_{1BB} D^*_{1BB}$.

(H27) $X_{2B} = D_{2BA} + D_{2BB}$.
$X^*_{2B} = \phi_{2BA} D^*_{2BA} + \phi_{2BB} D^*_{2BA}$.

The modifications necessary for the model with industry-specific capital are presented next.

Full Employment of Factors of Production

(S1) Unskilled labor in country A:

$$C^A_{L1} X_{1A} + C^A_{L2} X_{2A} + C^A_{LN} X_{NA} = L_A.$$
$$\lambda^A_{L1} X^*_{1A} + \lambda^A_{L2} X^*_{2A} + \lambda^A_{LN} X^*_{NA} + (\lambda^A_{L1} \theta^A_{S1} \sigma^{A1}_{LS} + \lambda^A_{L2} \theta^A_{S2} \sigma^{A2}_{LS}$$
$$+ \lambda^A_{LN} \theta^A_{SN} \sigma^{AN}_{LS})(q^*_A - w^*_A) + \lambda^A_{L1} \theta^A_{K1} \sigma^{A1}_{LK}(r^*_{1A} - w^*_A)$$
$$+ \lambda^A_{L2} \theta^A_{K2} \sigma^{A2}_{LK}(r^*_{2A} - w^*_A) + \lambda^A_{LN} \theta^A_{KN} \sigma^{AN}_{LK}(r^*_{NA} - w^*_A) = L^*_A$$
$$+ \lambda^A_{L1} \theta^A_{K1} \sigma^{A1}_{LK} \phi_{1AB} \mathrm{DISC1}A + \lambda^A_{L2} \theta^A_{K2} \sigma^{A2}_{LK} \phi_{2AB} \mathrm{DISC2}A.$$

Where the after-tax returns to capital in each industry no longer must change by the same percentage.

(S2) Skilled labor in country A:

$$C^A_{S1} X_{1A} + C^A_{S2} X_{2A} + C^A_{SN} X_{NA} = S_A.$$
$$\lambda^A_{S1} X^*_{1A} + X^A_{S2} X^*_{2A} + \lambda^A_{SN} X^*_{NA} + (\lambda^A_{S1} \theta^A_{L1} \sigma^{A1}_{LS} + \lambda^A_{S2} \theta^A_{L2} \sigma^{A2}_{LS}$$
$$+ \lambda^A_{SN} \theta^A_{LN} \sigma^{AN}_{LS})(w^*_A - q^*_A) + \lambda^A_{S1} \theta^A_{K1} \sigma^{A1}_{KS}(r^*_{1A} - q^*_A)$$
$$+ \lambda^A_{S2} \theta^A_{K2} \sigma^{A2}_{KS}(r^*_{2A} - q^*_A) + \lambda^A_{SN} \theta^A_{KN} \sigma^{AN}_{KS}(r^*_{NA} - q^*_A) = S^*_A$$
$$+ \lambda^A_{S1} \theta^A_{K1} \sigma^{A1}_{KS} \phi_{1AB} \mathrm{DISC1}A + \lambda^A_{S2} \theta^A_{K2} \sigma^{A2}_{KS} \phi_{2AB} \mathrm{DISC2}A.$$

(S3) Industry 1 capital in country A:

$$C^A_{K1} X_{1A} = K_{1A}.$$
$$X^*_{1A} + \theta^A_{L1} \sigma^{A1}_{LK}(w^*_A - r^*_{1A}) + \theta^A_{S1} \sigma^{A1}_{KS}(q^*_A - r^*_{1A}) = K^*_{1A}$$
$$- \theta^A_{L1} \sigma^{A1}_{LK} \phi_{1AB} \mathrm{DISC1}A - \theta^A_{S1} \sigma^{A2}_{KS} \phi_{1AB} \mathrm{DISC1}A.$$

(S4) Industry 2 capital in country A:

$$C^A_{K2} X_{2A} = K_{2A}.$$
$$X^*_{2A} + \theta^A_{L2} \sigma^{A2}_{LK}(w^*_A - r^*_{2A}) + \theta^A_{S2} \sigma^{A2}_{KS}(q^*_A - r^*_{2A}) = K^*_{2A}$$
$$- \theta^A_{L2} \sigma^{A2}_{LK} \phi_{2AB} \mathrm{DISC2}A - \theta^A_{S2} \sigma^{A2}_{KS} \phi_{2AB} \mathrm{DISC2}A.$$

(S5) Industry N capital in country A:

$$C^A_{KN}X_{NA} = K_{NA}.$$
$$X^*_{NA} + \theta^A_{LN}\sigma^{AN}_{LK}(w^*_A - r^*_{NA}) + \theta^A_{SN}\sigma^{AN}_{KS}(q^*_A - r^*_{NA}) = K^*_{NA}.$$

(S6) Unskilled labor in country B:

$$C^B_{L1}X_{1B} + C^B_{L2}X_{2B} + C^B_{LN}X_{NB} = L_B.$$
$$\lambda^B_{L1}X^*_{1B} + \lambda^B_{L2}X^*_{2B} + \lambda^B_{LN}X^*_{NB} + (\lambda^B_{L1}\theta^B_{S1}\sigma^{B1}_{LS} + \lambda^B_{L2}\theta^B_{S2}\sigma^{B2}_{LS}$$
$$+ \lambda^B_{LN}\theta^B_{SN}\sigma^{BN}_{LS})(q^*_B - w^*_B) + \lambda^B_{L1}\theta^B_{K1}\sigma^{B1}_{LK}(r^*_{1B} - w^*_B)$$
$$+ \lambda^B_{L2}\theta^B_{K2}\sigma^{B2}_{LK}(r^*_{2A} - w^*_B) + \lambda^B_{LN}\theta^B_{KN}\sigma^{BN}_{LK}(r^*_{NB} - w^*_B)$$
$$= L^*_B = 0.$$

(S7) Skilled labor in country B:

$$C^B_{S1}X_{1B} + C^B_{S2}X_{2B} + C^B_{SN}X_{NB} = S_B.$$
$$\lambda^B_{S1}X^*_{1B} + \lambda^B_{S2}X^*_{2B} + \lambda^B_{SN}X^*_{NB} + (\lambda^B_{S1}\theta^B_{L1}\sigma^{B1}_{LS} + \lambda^B_{S2}\theta^B_{L2}\sigma^{B2}_{LS}$$
$$+ \lambda^B_{SN}\theta^B_{LN}\sigma^{BN}_{LS})(w^*_B - q^*_B) + \lambda^B_{S1}\theta^B_{K1}\sigma^{B1}_{KS}(r^*_{1B} - q^*_B)$$
$$+ \lambda^B_{S2}\theta^B_{K2}\sigma^{B2}_{KS}(r^*_{2B} - q^*_B) + \lambda^B_{SN}\theta^B_{KN}\sigma^{BN}_{KS}(r^*_{NB} - q^*_B) = S^*_B = 0.$$

(S8) Industry 1 capital in country B:

$$C^B_{K1}X_{1B} = K_{1B}.$$
$$X^*_{1B} + \theta^B_{L1}\sigma^{B1}_{LK}(w^*_B - r^*_{1B}) + \theta^B_{S1}\sigma^{B1}_{KS}(q^*_B - r^*_{1B}) = K^*_{1B}.$$

(S9) Industry 2 capital in country B:

$$C^B_{K2}X_{2B} = K_{2B}.$$
$$X^*_{2B} + \theta^B_{L2}\sigma^{B2}_{LK}(w^*_B - r^*_{2B}) + \theta^B_{S2}\sigma^{B2}_{KS}(q^*_B - r^*_{2B}) = K^*_{2B}.$$

(S10) Industry N capital in country B:

$$C^B_{KN}X_{NB} = K_{NB}.$$
$$X^*_{NB} + \theta^B_{LN}\sigma^{BN}_{LK}(w^*_B - r^*_{NB}) + \theta^B_{SN}\sigma^{BN}_{KS}(q^*_B - r^*_{NB}) = K^*_{NB}.$$

And since the world stock of capital is given:

$$K_{1A} + K_{2A} + K_{NA} + K_{1B} + K_{2B} + K_{NB} = \bar{K},$$

then

$$K^*_{NB} = -(\lambda^A_{K1}k_{AB}/\lambda^B_{KN})K^*_{1A} - (\lambda^A_{K2}k_{AB}/\lambda^B_{KN})K^*_{2A}$$
$$- (\lambda^A_{KN}k_{AB}/\lambda^B_{KN})K^*_{NA} - (\lambda^B_{K1}/\lambda^B_{KN})K^*_{1B}$$
$$- (\lambda^B_{K2}/\lambda^B_{KN})K^*_{2B},$$

where $k_{AB} = K_A/K_B$.

Zero-Profit Equations in Production

(S11) Production of X_{1A} in country A:

$$C^A_{L1} w_A + C^A_{S1} q_A + C^A_{K1} r_{1A}/(1 - t_{1A}) = P_{1A}.$$
$$\theta^A_{L1} w^*_A + \theta^A_{S1} q^*_A + \theta^A_{K1} r^*_{1A} = P^*_{1A}.$$

(S12) Production of X_{2A} in country A:

$$C^A_{L2} w_A + C^A_{S2} q_A + C^A_{K2} r_{2A}/(1 - t_{2A}) = P_{2A}.$$
$$\theta^A_{L2} w^*_A + \theta^A_{S2} q^*_A + \theta^A_{K2} r^*_{2A} = P^*_{2A}.$$

(S13) Production of X_{NA} in country A:

$$C^A_{LN} w_A + C^A_{SN} q_A + C^A_{KN} r_{NA}/(1 - t_{NA}) = P_{NA} = 1.$$
$$\theta^A_{LN} w^*_A + \theta^A_{SN} q^*_A + \theta^A_{KN} r^*_{NA} = 0.$$

(S14) Production of X_{1B} in country B:

$$C^B_{L1} w_B + C^B_{S1} q_B + C^B_{K1} r_{1B} = P_{1B}.$$
$$\theta^B_{L1} w^*_B + \theta^B_{S1} q^*_B + \theta^B_{K1} r^*_{1B} = P^*_{1B}.$$

(S15) Production of X_{2B} in country B:

$$C^B_{L2} w_B + C^B_{S2} q_B + C^B_{K2} r_{2B} = P_{2B}.$$
$$\theta^B_{L2} w^*_B + \theta^B_{S2} q^*_B + \theta^B_{K2} r^*_{2B} = P^*_{2B}.$$

(S16) Production of X_{NB} in country B:

$$C^B_{LN} w_B + C^B_{SN} q_B + C^B_{KN} r_{NB} = P_{NB}.$$
$$\theta^B_{LN} w^*_B + \theta^B_{SN} q^*_B + \theta^B_{KN} r^*_{NB} = P^*_{NB}.$$

The nine demand equations are identical to those presented in the model with homogeneous capital, equations (H13) through (H21), and they are not repeated here. Also, the market equilibrium conditions (H23) through (H27) are unchanged. However, because several types of capital exist in the present model, there are four additional international capital flow equations, and each involves more pairwise comparisons than in the simpler model.

Capital Flow Equations

(S31) $K_{1A} = h_{1A}(r_{1A}, r_{1B}, r_{2A}, r_{NA}, r_{2B}, r_{NB}, \mathrm{CPI}_A, \mathrm{CPI}_B)$.

$$K^*_{1A} = g_{1A1B}(r^*_{1A} - \mathrm{CPI}^*_A - r^*_B + \mathrm{CPI}^*_B) + g_{1A2A}(r^*_{1A} - r^*_{2A}) + g_{1ANA}(r^*_{1A} - r^*_{NA}) + g_{1A2B}(r^*_{1A} - \mathrm{CPI}^*_A - r^*_{2B} + \mathrm{CPI}^*_B) + g_{1ANB}(r^*_{1A} - \mathrm{CPI}^*_A - r^*_{NB} + \mathrm{CPI}^*_B).$$

(S32) $K_{2A} = h_{2A}(r_{1A}, r_{1B}, r_{2A}, r_{2B}, r_{NA}, r_{NB}, \mathrm{CPI}_A, \mathrm{CPI}_B)$.

$$K^*_{2A} = g_{2A2B}(r^*_{2A} - \mathrm{CPI}^*_A - r^*_{2B} + \mathrm{CPI}^*_B) + g_{2A1A}(r^*_{2A} - r^*_{1A}) + g_{2ANA}(r^*_{2A} - r^*_{NA}) + g_{2A1B}(r^*_{2A} - \mathrm{CPI}^*_A - r^*_{1B} + \mathrm{CPI}^*_B) + g_{2ANB}(r^*_{2A} - \mathrm{CPI}^*_A - r^*_{NB} + \mathrm{CPI}^*_B).$$

(S33) $K_{NA} = h_{na}(r_{1A}, r_{1B}, r_{2A}, r_{2B}, r_{NA}, r_{NB}, \mathrm{CPI}_A, \mathrm{PCI}_B)$.

$$K^*_{NA} = g_{NA1A}(r^*_{NA} - r^*_{1A}) + g_{NA2A}(r^*_{NA} - r^*_{2A}) + g_{NA1B}(r^*_{NA} - \mathrm{CPI}^*_A - r^*_{1B} + \mathrm{CPI}^*_B) + g_{NA2B}(r^*_{NA} - \mathrm{CPI}^*_A - r^*_{2B} + \mathrm{CPI}^*_B) + g_{NANB}(r^*_{NA} - \mathrm{CPI}^*_A - r^*_{NB} + \mathrm{CPI}^*_B).$$

(S34) $K_{1B} = h_{1B}(r_{1A}, r_{1B}, r_{2A}, r_{2B}, r_{NA}, r_{NB}, \mathrm{CPI}_A, \mathrm{CPI}_B)$.

$$K^*_{1B} = g_{1B1A}(r^*_{1B} - \mathrm{CPI}^*_B - r^*_{1A} + \mathrm{CPI}^*_A) + g_{1B2B}(r^*_{1B} - r^*_{2B}) + g_{1BNB}(r^*_{1B} - r^*_{NB}) + g_{1B2A}(r^*_{1B} - \mathrm{CPI}^*_B - r^*_{2A} + \mathrm{CPI}^*_A) + g_{1BNA}(r^*_{1B} - \mathrm{CPI}^*_B - r^*_{NA} + \mathrm{CPI}^*_A).$$

(S35) $K_{2B} = h_{2B}(r_{1A}, r_{1B}, r_{2A}, r_{2B}, r_{NA}, r_{NB}, \mathrm{CPI}_A, \mathrm{CPI}_B)$.

$$K^*_{2B} = g_{2B2A}(r^*_{2B} - \mathrm{CPI}^*_B - r^*_{2A} + \mathrm{CPI}^*_A) + g_{2B1B}(r^*_{2B} - r^*_{1B}) + g_{2BNB}(r^*_{2B} - r^*_{NB}) + g_{2B1A}(r^*_{2B} - \mathrm{CPI}^*_B - r^*_{1A} + \mathrm{CPI}^*_A) + g_{2BNA}(r^*_{2B} - \mathrm{CPI}^*_B - r^*_{NK} + \mathrm{CPI}^*_A).$$

Where the elasticity values within equations are restricted in accord with the pattern described in equation (28) of the text, and values across equations fulfill the following types of constraints:

$$\frac{\partial K_{1A}}{\partial(r_{1A}/r_{1B})} = -\frac{\partial K_{1B}}{\partial(r_{1A}/r_{1B})}.$$

$$K_{1A}\frac{(r_{1A}/r_{1B})}{K_{1A}} \cdot \frac{\partial K_{1A}}{\partial(r_{1A}/r_{1B})} = -\frac{(r_{1A}/r_{1B})}{K_{1B}} \frac{\partial K_{1B}}{\partial(r_{1A}/r_{1B})} \cdot K_{1B}.$$

$$\frac{K_A}{K_B} \cdot \frac{K_{1A}}{K_A} \cdot g_{1A1B} = -\frac{K_{1B}}{K_B} g_{1B1A}.$$

$$k_{AB} \cdot \lambda^A_{K1} \cdot g_{1A1B} = -\lambda^B_{K1}\, g_{1B1A}.$$

Appendix C

In this appendix the net efficiency or welfare effects of adopting DISC are explained. An initial assumption is that a community welfare function exists, and its value depends on aggregate consumption of the five goods available within a country. More accurately, then, potential welfare is measured, since no attention is paid to the redistributive policies within the country determining actual welfare. This welfare function is represented as

$$\text{(A1)} \qquad U_A = U(D_{1AA}, D_{1BA}, D_{2AA}, D_{2BA}, D_{NA}).$$

Given that a price ratio equals the corresponding ratio of marginal utilities in equilibrium, a change in utility can be expressed as

$$\text{(A2)} \qquad \frac{dU_A}{U_{NA}} = P_{1A}dD_{1AA} + P_{1B}dD_{1AB} + P_{2A}dD_{2AA} + P_{2B}dD_{2AB} + dD_{NA},$$

where U_{NA} is the marginal utility of consuming an additional unit of X_{NA}. Since there is no net saving in this model, a change in the value of consumption must equal a change in the value of income, which allows equation (A2) to be rewritten as:

$$\text{(A3)} \qquad \frac{dU_A}{U_{NA}} = dY_A - D_{1AA}dP_{1A} - D_{1BA}dP_{1B} - D_{2AA}dP_{2A} - D_{2BA}dP_{2B}.$$

Although income was expressed in terms of output in the text, to analyze welfare changes it is more useful to work from the comparable definition in terms of factor income:

$$\text{(A4)} \qquad Y_A = w_A L_A + q_A S_A \frac{(r_A)}{1 - t_{1A}} K_{1A} + \frac{(r_A)}{1 - t_{2A}} K_{2A} + \frac{(r_A)}{1 - t_{NA}} K_{NA} + r_B(\bar{K}_A - K_A) + \text{TAR}_{1A} \cdot P_{1B}D_{1BA} + \text{TAR}_{2A} \cdot P_{2B}D_{2BA} - \text{DISCREV}.$$

Differentiating this equation results in an expression to use in equation (A3) for dY_A. Based on the zero-profit conditions in the production of X_{1A}, X_{2A}, and X_{NA}, the factor reward terms dw_A, dg_A, and dr_A can be eliminated, giving

$$\text{(A5)} \qquad \frac{dU_A}{U_{NA}} = (X_{1A} - D_{1AA})dP_{1A} + (X_{2A} - D_{2AA})dP_{2A} - D_{1BA}\,dP_{1B} - D_{2BA}\,DP_{2B} - \text{DISCREV} + \frac{(r_A)}{1 - t_{1A}} dK_{1A} + \frac{(r_A)}{1 - t_{2A}} dK_{2A} + \frac{(r_A)}{1 - t_{NA}} dK_{NA} - r_B\,dK_A + (\bar{K}_A - K_A)(dr_B/\text{CPI}_B - r_B d\text{CPI}_B) + \text{TAR}_{1A} \cdot d(P_{1B}D_{1BA}) + \text{TAR}_{2A} \cdot d(P_{2B}D_{2BA}).$$

The r_B and CPI_B terms require some explanation. They reflect the possibility that as capital abroad depreciates, it can be replaced by spending

less than the initial allowance for depreciation because the real prices of capital goods have declined. Dividing both sides of the equation by Y_A gives the percentage change in welfare as:

$$
\begin{aligned}
\text{(C-6)} \qquad \frac{dU_A}{U_{NA}}\frac{1}{Y_A} = U^* = {} & \frac{P_{1A}X_{1AB}}{Y_A}P^*_{1A} + \frac{P_{2A}X_{2AB}}{Y_A}P^*_{2A} \\
& - \frac{P_{1B}D_{1BA}}{Y_A}P^*_{1B} - \frac{P_{2B}D_{2BA}}{Y_A}P^*_{2B} - \text{DISCREV} \\
& + \frac{r_A K_{1A}}{(1-t_{1A})Y_A}K^*_{1A} + \frac{r_A K_{2A}}{(1-t_{2A})Y_A}K^*_{2A} \\
& + \frac{r_A K_{NA}}{(1-t_{NA})Y_A}K^*_{NA} - \frac{r_B K_A}{\text{CPI}_B Y_A}K^*_A \\
& + \frac{r_B(\tilde{K}_A - K_A)}{\text{CPI}_B Y_A}(r^*_B - \text{CPI}^*_B) \\
& + \frac{\text{TAR}_{1A}\cdot P_{1B}D_{1BA}}{Y_A}(P^*_{1B} + D^*_{1BA}) \\
& + \frac{\text{TAR}_{2A}\cdot P_{2B}D_{2BA}}{Y_A}(P^*_{2B} + D^*_{2BA}).
\end{aligned}
$$

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Comment

Stephen P. Magee

This is a very comprehensive and, I think, quite competent paper on both theoretical and empirical considerations related to the DISC. I have only two brief comments. The first is that there is no necessary reason why we might expect an increase in the DISC to also be associated with an expansion of U.S. exports. If the DISC were obtained in an endogenous policy model in which resources are removed from export production in order to effect the adoption of DISC, then the increase in rent seeking

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could cause a decline in exports at the very time when the DISC is adopted. Of course, this does not mean that the welfare of exporting interests is harmed. The favorable tax benefits could easily offset the reduction in the quantity of exports in such a way that the exporter's welfare would improve.

A second and related point is that in an endogenous policy model, causation does not run from the change in the policy to the change in exports. Rather, both exports and the policy itself are caused by other underlying determinants.

Both of these points are outside the scope of the current model and should not be interpreted as a direct criticism of an obviously fine paper.

Comment William R. Cline

John Mutti and Harry Grubert have provided an impressive analysis of the DISC. Their model brings out important effects that would be missed in a partial equilibrium approach. As a major example, it is only with a general equilibrium analysis that they are able to identify adverse effects of the DISC on unskilled labor, arising primarily from the reduction of output and employment in nontraded goods caused by reallocation of resources to exportables.

Certain elements of the model do raise questions. The basic price equations are composed only of factor costs; there is no treatment of costs of intermediate inputs. Even considering that the model is aggregative and therefore that intermediates tend to disappear, there should nonetheless be inputs from even the three broad aggregate sectors into each other. Similarly, it is not apparent how the model takes into account imported intermediate inputs.

It is noteworthy that the welfare effects cited are small while the transfer effects are large; in this regard, the analysis of DISC shows results symmetrical to those of trade protection.

The model results are driven crucially by the balance-of-payments constraint. This constraint is the main cause of a reduction of output in the sector of import substitutes (sector 1*A*). That is, with the balance of payments constrained to be unchanged, import substitutes at home must be partially replaced by imported goods to compensate for the DISC-induced rise in exports.

Other specifics warrant mention. The parameter 1.25 as an elasticity of substitution would seem high for categories as broad as the three economy-wide categories used. (Can education services, good 3, readily be substituted in demand for grain, good 2, or oil, good 1?) The results for

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rate of return to capital in the partner country are puzzling: as the stock of capital in country *B* declines because of a reallocation of capital away from *B* to country *A*, it might have been expected that the rate of return to capital rises in response to greater scarcity; instead, it declines (table 8.2).

Despite these assorted questions about the model itself, it would appear to provide a useful representation of the economic effects of DISC. My remaining comments therefore focus on the political economy of DISC. In terms of the paper itself, the analysis brings out a powerful and heretofore unrecognized argument against DISC: this tax mechanism *reduces* jobs and output in import-competing industries. If labor and management in steel, automobiles, and textiles were aware of this analytical conclusion and agreed with it, DISC's days would be numbered. Even more significant politically, the main effect of DISC identified by Mutti and Grubert is not that it increases U.S. exports, but instead that it reduces the wage of unskilled labor. This finding, a result of the reduced output of (labor-intensive) nontradables as resources shift to exports, should be a politically sensitive strike against DISC if past experience in the field of import protection (where impact on unskilled labor is a significant consideration) is any guide.

It must be noted, however, that these key results turn on the assumption of unchanged balance of payments. Country *B*'s exports must increase to offset the rise in country *A*'s exports. Yet the implicit assumption of the creators of DISC is just the opposite. DISC exists to increase the net trade balance of the United States, not to reshuffle workers and resources from import substitutes to export products. In theoretical terms, that underlying political-economic premise cannot be justified except perhaps in periods of obvious overvaluation of the exchange rate. As it happens, however, the United States is currently in just such a period; the dollar is perhaps 20 percent above an equilibrium level, while the trade deficit for 1983 could reach $70 billion or more and the current account deficit correspondingly would also be large. In this context, especially if the dollar is to remain overvalued as the consequence of mismatch between tight monetary and loose fiscal policy (because of inability to act in reducing budget deficits), second-best instruments that do raise the trade balance (rather than leaving it unchanged, as in the Mutti-Grubert analysis) may be appropriate. If DISC, the Export-Import Bank, and other export-stimulating devices are ever justified, it is in periods such as the present.

Even in terms of the goals of the legislators who created DISC, however, it seems to be ineffective, judged by the Mutti-Grubert analysis. It increases exports only by 2 percent. This finding is not a great surprise, considering that its subsidy equivalent amounts to only 1.7 percent of the export price, which in turn reflects the fact that DISC reduces capital

costs only by 11 percent, and capital costs themselves are only one-fifth of product price.

The paper's implicit policy recommendation is to use the Export-Import Bank as the preferred vehicle for stimulating U.S. exports (if that objective is taken as given), and more specifically, the Export-Import Bank's support should be focused on those U.S. exports that are price-elastic in foreign demand. That is, the United States should be a price-discriminating monopolist.

Other major issues arise in a broader policy context than that directly addressed by the Mutti-Grubert study. Perhaps the most important is that DISC is the Achilles' heel of U.S. policy on trade subsidies. Subsidies are certain to be a key area of trade conflict in the 1980s and beyond. Other countries are emphasizing industrial policies, and that strategy inevitably means subsidies. In some cases the results of these subsidies are and will be trade distorting. But the United States will not be in a credible position to insist on greater adherence of the EEC, Japan, and others to GATT principles on subsidies as long as the DISC stands in flagrant violation of those principles. It is important for U.S. ability to negotiate that DISC be abolished or at least reformed.

If DISC is eliminated, some substitute will be needed in practical political terms. The Export-Import Bank is the best substitute. Unfortunately, it is not trusted as a permanent alternative because administrations have found it too easy to cut its funding in the past. Moreover, the Export-Import Bank is viewed to some extent as narrowly concentrated in favor of large firms, such as aircraft producers, while DISC is an across-the-board instrument.

For its part, the Reagan administration is committed to the elimination of DISC and its replacement by something that is compatible with the GATT. Just what that might be remains unclear.

One proposed alternative would be the FISC—a Foreign International Sales Corporation. This strategy would essentially move all DISCs to post boxes in offshore locations that do not tax, following the lead of the Belgians and French, whose export tax subsidies they justify on grounds that they occur offshore. Nontaxation of foreign operations is accepted by GATT practice. The risk of the FISC is that it will be considered to be an artificial device, equivalent to a tax haven, designed to circumvent DISC's violations of GATT; major foreign countries would seem unlikely to judge such a vehicle as truly GATT-compatible.

The best policy strategy would be to eliminate DISC entirely. To this end, it would be necessary to reshape political alliances by highlighting the small export effects of DISC and, more importantly, its adverse effect on output and employment in import-competing industries and on wages of unskilled labor. As a complement to this strategy it would also be appropriate to enlarge the Export-Import Bank's activity as long as the United States maintains a substantially overvalued exchange rate.