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Chapter Author: Lawrence H. Goulder, Barry Eichengreen

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1 Savings Promotion, Investment Promotion, and International Competitiveness

Lawrence H. Goulder and Barry Eichengreen

Over the past two decades, international economic transactions have become increasingly important to the U.S. economy. Increased openness poses a challenge to tax policy analysts, who must now consider new channels through which policy initiatives may operate. In an open economy, it is important, for example, to distinguish policies aimed at stimulating saving from those targeted at promoting investment. The distinction gains importance to the extent that there is international mobility of financial capital; in its presence, as Summers (1988) and others have pointed out, the two types of policies are likely to have opposite effects on capital flows, exchange rates, and the performance of tradables industries.[1]

Analytic studies have been useful in identifying potential differences between savings- and investment-promoting policies in an open economy. Unfortunately, the sign as well as the magnitude of the long-run effects of these policies on many important variables (such as the current account of the balance of payments) are analytically indeterminate (see, e.g., Summers 1986). In other analytic studies, the short-term effects are indeterminate as well.[2]

Under these circumstances, numerical simulation can play an important role. Previous attempts to simulate the effects of growth-oriented tax policies within a dynamic, open-economy framework include the computable general

Lawrence H. Goulder is associate professor of economics at Harvard University and a faculty research fellow of the National Bureau of Economic Research. Barry Eichengreen is professor of economics at the University of California, Berkeley, and a research associate of the National Bureau of Economic Research.

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equilibrium (CGE) simulations of Goulder, Shoven, and Whalley (1983), who found that the welfare effects of promoting savings through a consumption tax can be reversed when closed-economy assumptions are relaxed. Mutti and Grubert (1985) extended this analysis by introducing foreign production explicitly and by treating foreign tax systems more realistically. They confirmed that even a limited degree of international capital mobility can significantly alter results from closed-economy models. Bovenberg (1986) presented a two-country, two-good model that integrates the short- and long-run responses to tax policy changes. An attraction of Bovenberg's work is its more compelling treatment of time: Mutti and Grubert consider only steady-state results; in Goulder, Shoven, and Whalley (1983), the behavior of firms is not grounded in intertemporal optimization.

The present study combines many of the attractive features of these models. Like Bovenberg's, our model is intertemporal and characterizes not only the long-run (steady-state) effects of policy initiatives but also short-run responses and the transition to the new steady state. Decisions of consumers and producers in the United States and abroad derive from intertemporal optimization. In contrast to Bovenberg's model, but like the others above, our model is applied to actual U.S. data and contains a great deal of detail on production and taxes. We distinguish ten domestic industries, each with a different technology. Industries differ in the extent of their dependence on the export market and in the degree to which they compete with foreign producers. The model departs from previous work by treating financial behavior in considerable detail.

There is a natural complementarity between our disaggregated model of the U.S. economy and aggregated multicountry models such as that of McKibbin and Sachs (1986). While their model considers six countries (regions), it does not disaggregate industries within countries. Our model distinguishes only two countries (the United States and the rest of the world) but offers much additional industry and tax detail. Both models are based on full intertemporal optimization.

Our model preserves many features of the model of Goulder and Summers (1989), from which the present work developed, but pays far more attention to open-economy aspects. In contrast to Goulder and Summers, we derive the behavior of the foreign sector from optimizing behavior. We also introduce an international market for financial capital: domestic and foreign households each hold portfolios consisting of assets from both countries, as in Kouri (1976). Portfolio decisions give rise to capital account transactions, which are integrated with transactions on current account.

In this paper, we employ the model to assess the short- and long-run effects of savings- and investment-promoting changes in U.S. tax policy. We contrast a savings subsidy (effected through reduced income taxes and higher taxes on consumption) with investment tax credits (restored to their effective rates prior to implementation of the Tax Reform Act of 1986). Our focus is on the implications of these policies for "international competitiveness," measured here by the profitability and output of U.S. export industries. We compare results under the assumption of no international capital mobility (and no international asset transactions) with those under the assumption of full international mobility (which assumes that there are no barriers to or costs of such transactions). In the case of capital mobility, we consider the importance of the degree of international asset substitutability. At one extreme is zero substitutability, where households hold domestic and foreign assets in fixed proportions. At the other is perfect substitutability, where households are indifferent between the two assets and drive the returns to equality. In general, we concentrate on intermediate cases.

Our simulation results show that the implications of these policies for international competitiveness differ radically once international capital mobility is introduced. In the absence of such mobility, investment- and savings-promoting policies each have only minor effects on U.S. export industries in the short run. In the long run, the effects of both policies are favorable since both raise the capital intensity of U.S. production, increasing productivity and incomes, reducing U.S. goods prices, and raising the overall volume of trade, all to the benefit of the export sector. Once international capital mobility is introduced, however, the effects of the two policies differ from one another in both the short and the long run. Restoring investment tax credits hurts U.S. export industries initially but helps them over the longer term. The reverse is true for the policy of exempting savings from the income tax. These differences reflect the very different implications of the two types of policies for the capital account of the balance of payments.

The rest of the paper is organized as follows. Section 1.1 offers an overview of our dynamic, open-economy CGE model. Section 1.2 lays out the structure of the model in greater detail. Section 1.3 and 1.4 describe how we solve and calibrate the model. In Section 1.5, we present our simulation results, and the final section offers conclusions.

1.1 Overview of the Model

Large CGE models are complex and all too often inaccessible. To render our model as transparent as possible, we describe here a simple heuristic model with features similar to those of the larger model used for simulations. We then describe how the larger model differs from the simple one.

1.1.1 An Illustrative Model

Behavioral Specifications

Consider a two-country model[3] in which each country's output is produced according to linearly homogenous production functions with labor and capital inputs:

$$X = f(K, L), \tag{1}$$

$$X^* = f^*(K^*, L^*). \tag{2}$$

The variables L and K are inputs of labor and capital in home-country production, L^* and K^* are the corresponding inputs into production in the foreign country (asterisks are used throughout to denote foreign-country variables), and X and X^* are outputs of each country. Labor supply is exogenous at each point in time. Neither labor nor physical (as distinct from financial) capital is mobile internationally.

Total domestic and foreign human wealth, TWH and TWH*, can be expressed as

$$\text{TWH} = \text{PV}(wL, i), \tag{3}$$

$$\text{TWH}^* = \text{PV}(w^*L^*, i^*), \tag{4}$$

where w (w^*) is the wage, i (i^*)is the market interest rate, and PV $(\cdot\ ,\ \cdot)$ is the present value operator, defined on flows and interest rates over all time. If investment is financed solely by retained earnings and firms must offer a rate of return to equity owners equal to the market interest rate, then total nonhuman wealth generated in each country is equal to the present value of the flow of dividends; that is,

$$\text{TWK} = \text{PV}(pX - wL - pI, i), \tag{5}$$

$$\text{TWK}^* = \text{PV}(p^*X^* - w^*L^* - p^*I^*, i^*), \tag{6}$$

where p (p^*) is the price of domestic (foreign) output and I is the quantity of new capital goods purchases.[4] The variables TWK and TWK* are denominated in the respective currencies of the two countries. In this simple model, the produced good can be used for consumption or investment, and investment in each country is a function of the interest rate.

Income, consumption, and saving of each household are expressed in local currency. At each moment of time, total income Y (Y^*) received by the domestic (foreign) household consists of labor and capital income:

$$Y = wL + \gamma\text{DIV} + (1 - \gamma^*)\text{DIV}^*/e, \tag{7}$$

$$Y^* = w^*L^* + \gamma^*\text{DIV}^* + (1 - \gamma)\text{DIV} \cdot e, \tag{8}$$

where γ is the share of TWK owned by domestic households, γ^* is the share of TWK* owned by foreign households, DIV $= pX - wL - pI$ (similarly for DIV*), and e is the nominal exchange rate, defined as units of foreign currency per dollar. The value of consumption of each household depends on the household's total wealth and the average return on its investments:

$$C = C(\text{TWH} + \gamma\text{TWK} + (1 - \gamma^*)\text{TWK}^*/e, \bar{r}), \tag{9}$$

$$C^* = C^*(\text{TWH}^* + \gamma^*\text{TWK}^* + (1 - \gamma)\text{TWK} \cdot e, \bar{r}^*), \tag{10}$$

where $\bar{r}$ ($\bar{r}^*$) is the average return on the domestic (foreign) household's portfolio, a weighted average of the returns on domestic and foreign assets.

Let α (α^*) denote the share of the domestic (foreign) household's wealth that it wishes to hold in assets located domestically (abroad). Assets from the two countries are imperfect substitutes in portfolios, with the desired portfolio shares a function of the relative rates of return (inclusive of exchange rate changes, where the dot over a variable represents its time derivative):

(11) $$\alpha = \alpha(i, i^* - \dot{e}/e),$$

(12) $$\alpha^* = \alpha^*(i + \dot{e}/e, i^*).$$

When policy shocks alter relative rates of return on domestic and foreign assets, desired portfolio shares change. At each moment in time, the capital account reflects changes in the composition of households' portfolios as well as overall increases in the value of portfolios associated with their saving. Let $S_i(= Y_i - C_i)$ represents the total saving by households resident in country i, and let S_{ij} denote the net incremental demand by household i for financial assets of country j. Households divide S_i into purchases of assets from the two countries so as to attain desired portfolio shares.

Let C_{ij} represent the expenditure by household i devoted to consumption of goods from country j. Assuming that domestic and foreign goods are imperfect substitutes in consumption, with the demands for each type of good a function of relatives prices, then

(13) $$C_{ij} = C_{ij}(C_i, pe/p^*).$$

Equilibrium Conditions

At each moment of time, equilibrium requires that the following conditions hold:

(14) $$w/p = f_L(K, L),$$

(15) $$w^*/p^* = f_L^*(K^*, L^*),$$

(16) $$C_{DD} + C_{FD}/e + pI = pX,$$

(17) $$C_{FF} + C_{DF} \cdot e + p^*I^* = p^*X^*,$$

(18) $$pI = S_{DD} + S_{FD}/e,$$

(19) $$p^*I^* = S_{FF} + S_{DF} \cdot e.$$

Here D and F subscripts denote "domestic" and "foreign." Equations (14) and (15) express the requirement that labor supply and demand balance in each country. Equations (16) and (17) show the conditions for equality of output demand and supply. The final two equations indicate the conditions for savings-investment equality in each country. Note that the balance of payments requirement,

(20) $$C_{FD}/e + (1 - \gamma^*)\mathrm{DIV}^*/e - C_{DF} - (1 - \gamma)\mathrm{DIV} = S_{DF} - S_{FD}/e,$$

is assured by equations (14)–(19) and Walras's law; it does not constitute an independent equilibrium condition.

1.1.2 The Larger Model

Behavioral Specifications

The larger model extends the simpler one in several ways. One major difference is in the degree of industry disaggregation. Our model distinguishes ten U.S. industries: agriculture and mining, crude petroleum and refining, construction, the textile and apparel complex, metals, machinery, motor vehicles, miscellaneous manufacturing, services, and housing.[5] This disaggregation enables us to address a number of topical issues relating to U.S. international competitiveness: the effects of restrictions on agricultural exports, the effects of import penetration in textiles, steel, and automobiles, and the effects of increased trade in services. The model also incorporates intermediate goods production and substitution by producers between domestic and foreign intermediate goods.

The larger model treats investment dynamics explicitly. In each industry, managers choose levels of investment to maximize the value of the firm. Because of adjustment costs associated with the installation or removal of new physical capital, firms find it optimal, in response to a change in economic conditions, to approach new long-run capital intensities gradually over time.[6]

The larger model treats corporate financial decisions in some detail. As in Goulder and Summers (1989), we model firms as financing investments through both debt and equity issues.[7]

Finally, the larger model incorporates taxes and spending by the U.S. government. It distinguishes taxes that apply to existing capital (e.g., the corporate income tax) from taxes that apply only to new capital (e.g., investment tax credits), and it accounts for the different effects of these two types of taxes on investment incentives and asset values. The spending and transfer roles of the government are modeled explicitly.

Equilibrium Conditions

In each country, four types of equilibrium conditions must be satisfied in each period. First, commodity market equilibrium requires that the supply of each good equal the sum of home and foreign demands. Second, labor market equilibrium requires that the aggregate supply and aggregate demand for labor balance. Third, savings-investment equilibrium requires that the aggregate demand for external funds by home firms equal the sum of national savings and net capital inflows. All three conditions were present in the simpler model above. Introduction of a government sector adds a fourth requirement (for each country): that total tax revenues must equal total government spending.

These equilibrium requirements are met through the adjustment of domestic and foreign wages, domestic and foreign commodity prices, domestic and foreign interest rates, the nominal exchange rate, and lump-sum adjustments to personal income taxes.[8] But, since current-period decisions depend on forward-looking expectations, the current-period prices that satisfy the market-clearing conditions in a given period depend on expectations of future prices (when agents have foresight, as is assumed here, current equilibrium prices depend on future equilibrium prices). Given this intertemporal interdependence, we solve the model by transforming the general equilibrium problem into one in which current and future prices are effectively solved separately (as described in sec. 1.3 below). This enables us to solve for the set of prices for each period that yields the intertemporal general equilibrium under perfect foresight expectations.

Dynamics

The path of the domestic and foreign economies over time depends on the adjustments of capital stocks and asset portfolios to policy initiatives and other exogenous shocks. The model has steady-state properties: in the long run, asset prices and rates of return adjust so that the rates of net accumulation of physical capital by industry and the rates of accumulation of financial capital by households equal g, the growth rate of effective labor services. This yields a steady state in which relative prices do not change and all quantities increase at the rate g.

In the short run, policy shocks generate divergences in the marginal product of capital across industries as well as in average portfolio returns to domestic and foreign residents. In the long run, firms' investment decisions ultimately equalize marginal products of capital across industries (adjusted for taxes and risk), while household portfolio decisions and savings behavior ultimately equalize overall portfolio returns. The adjustment dynamics associated with firms' investment decisions have been described by Goulder and Summers (1989). The adjustment dynamics associated with household portfolio decisions, on the other hand, are more complex in this model because of the introduction of international asset transactions. Assuming that assets issued by firms in different countries are imperfect substitutes in portfolios and that households display home-country preference, then a positive shock to domestic firms that increases the rate of return on dollar-denominated assets will raise the average rate of return on the portfolios of domestic residents relative to the average portfolio return to foreign residents. If the difference in portfolio returns were to be sustained and propensities to save were similar across countries, domestic residents would accumulate an ever-increasing share of global wealth—a result inconsistent with the existence of a steady state. What prevents this process from persisting is that the higher accumulation rate of U.S. residents, under the assumption of home-country preference, implies an increase in the share of global savings invested in the U.S.

economy. Over time, this lowers the domestic rate of return until average returns on domestic and foreign portfolios are brought to equality. The long-run equalization of returns on portfolios brought about by households' savings behavior parallels the long-run equalization of marginal products of capital brought about by firms' investment decisions.

1.2 A Detailed Description of the Model

1.2.1 Production

U.S. Industries

Production Technologies. Each of the ten domestic industries produces a single output using inputs of labor, capital, and intermediate goods. A multilevel structure governs the production of each industry output (see table 1.1). Firms choose the quantity of labor that maximizes current profits, given the current capital stock. Labor and capital combine to produce a value-added composite, VA. This composite is then combined with intermediate inputs ($\bar{x}_1, \bar{x}_2, \ldots, \bar{x}_N$) in fixed proportions to generate output, x.

Intermediate inputs are themselves composites of foreign- and domestic-supplied intermediate goods. Treating domestic and foreign intermediates as imperfect substitutes in production endogenizes the relative prices of domestic and foreign intermediate goods. For a given intermediate good of type i, producers choose the combination of domestic and foreign inputs that minimizes costs.[9]

The producer good outputs of the ten industries have several end uses. They too serve as inputs for each industry. In addition, they satisfy the demand for final goods by government and the demand for U.S. exports by foreigners. Finally, they combine in fixed proportions to produce a representative capital good used in production and to create the seventeen consumer goods demanded by households.[10]

Producer Behavior. Managers seek to maximize the value of the firm. Their choice variables at each point in time are employment, intermediate inputs, and investment. Labor and intermediates are chosen to maximize current

Table 1.1 Industry Production Structure

Production Relation	Functional Form
$X = X(\text{VA}, \bar{x}_1, \bar{x}_2, \ldots, \bar{x}_N)$	Leontief
$\text{VA} = \text{VA}(L, \bar{K})$	CES
$\bar{x}_i = \bar{x}_i(x_i, x_i^*), \quad (i = 1,2, \ldots, N)$	CES

Note: X = gross output (exclusive of adjustment costs); VA = value added; L = labor input; $\bar{K}$ = capital input (fixed in the current period of time); $\bar{x}_i$ = composite intermediate input ($i = 1, \ldots, N$); x_i = intermediate domestically produced input ($i = 1, \ldots, N$); and x_i^* = intermediate foreign-produced input ($i = 1, \ldots, N$).

profits (given the capital stock), while investment is chosen to approach optimally the long-run (profit-maximizing) capital intensity. The time required to attain the optimal capital intensity depends on adjustment costs.

A starting point for specifying the firm's behavior is the asset market equilibrium condition that risk-adjusted expected returns be equalized across domestic assets. The expected return from holding (risky) equities must be consistent with those from holding a "safe" asset such as corporate debt. The return on equity is the sum of capital gains and dividends net of tax. For every firm at each point in time,

$$(21) \qquad (1 - \kappa)\frac{\dot{V} - \mathrm{VN}}{V} + (1 - \theta)\frac{\mathrm{DIV}}{V} = i(1 - \theta) + \eta,$$

where V is the value of the firm, VN is new share issues, DIV is the current dividend, κ is the capital gains tax rate, θ is the marginal income tax rate, i is the normal interest rate on domestic corporate debt, and η is the equity risk premium. Imposing a transversality condition ruling out eternal speculative bubbles and integrating yield an expression equating the value of the firm with the discounted value of after-tax dividends net of share issues:

$$(22) \qquad V_t = \int_t^{\infty}\left[\left(\frac{1 - \theta}{1 - \kappa}\right)\mathrm{DIV}_s - \mathrm{VN}_s\right] exp\left[\int_t^s \frac{-r_u}{1 - \kappa}du\right]ds,$$

where r is the risk-adjusted rate of return, equal to $i(1 - \theta) + \eta$.[11]

Dividends and new share issues in each period are related through the cash-flow identity equating sources and uses of funds:

$$(23) \qquad \mathrm{EARN} + \mathrm{BN} + \mathrm{VN} = \mathrm{DIV} + \mathrm{IEXP},$$

where EARN represents earnings after taxes and interest payments, BN is the value of new debt issue, and IEXP is the value of investment expenditure. Earnings are given by

$$(24) \quad \mathrm{EARN} = [pF(K, L, M) - wL - p_M M - i\mathrm{DEBT}](1 - \tau) + \tau D,$$

where

K and L	=	inputs of capital and labor;
M	=	vector of domestic and foreign intermediate inputs;
p	=	output price (net of output taxes);
F	=	quantity of output (gross of adjustment costs);
w	=	wage rate (gross of indirect tax on labor);
P_M	=	vector of intermediate input prices (gross of tariffs and intermediate input taxes facing the industry);
$DEBT$	=	nominal debt;
τ	=	corporate tax rate; and
D	=	value of currently allowable depreciation allowances.

To determine the value of the firm, it is necessary to specify the firm's financial behavior and identify the elements BN, VN, and DIV in equation

(23). We assume that firms pay dividends equal to a constant fraction, a, of after-tax profits net of economic depreciation and that they issue new debt to maintain a constant debt-capital ratio, b. We also assume that new equity issues represent the marginal source of finance: that is, they make up the difference between EARN + BN and DIV + IEXP in (23).[12]

Investment expenditure is the sum of the "direct" costs of the new capital (net of the investment tax credit) plus adjustment costs associated with its installation:

$$\text{(25)} \qquad \text{IEXP} = (1 - \text{ITC})p_K I + (1 - \tau)p\phi I,$$

where ITC represents the investment tax credit rate, p_K is the purchase price of new capital goods, I is the quantity of investment, and $\phi(I/K)$ is adjustment costs per unit of investment. We model adjustment costs as internal to the firm: to add capital, currently available resources (labor, existing capital, and intermediate goods) must be devoted to installation.[13] Output is separable between inputs and adjustment costs:

$$\text{(26)} \qquad X = F(K, L, M) - \phi I.$$

Using the expression for the change in the capital stock,

$$\text{(27)} \qquad \dot{K} = I - \delta^R K,$$

one can derive an expression for the value of the firm in terms of I, L, M, prices, and the technology. Firms maximize this value subject to (27). As detailed in Goulder and Summers (1989), optimal investment is given by

$$\text{(28)} \quad \frac{I}{K} = h(Q) = h\left\{\left[\frac{V - B}{p_K K} - 1 + \text{ITC} + b + \omega Z\right]\left[\frac{p_K}{(1 - \tau)p}\right]\right\}$$

where $h(\cdot) = [\phi + (I/K)\phi']^{-1}$, B is the present value of depreciation allowances on existing capital, Z is the present value of depreciation allowances on a dollar of new investment, and $\omega = a(1 - \theta)/(1 - \kappa) - a + 1$. The adjustment cost function is

$$\text{(29)} \qquad \phi(I/K) = \frac{\beta/2(I/K - \zeta)^2}{I/K},$$

implying that the relation between the rate of investment and Q is simply

$$\text{(30)} \qquad \frac{I}{K} = \zeta + \frac{1}{\beta}Q,$$

where β is the adjustment cost parameter. Since they are defined in terms of discounted streams of dividends and depreciation allowances, V, B, and Z in the investment equation (28) incorporate expectations about the future. The calculation of perfect foresight expectations is discussed in section 1.3 below.

Foreign Industry

The treatment of foreign production is analogous. A representative foreign producer generates output using capital and labor inputs. The specification of investment is the same as for domestic firms, as are the foreign producer's financing rules. Total nonhuman wealth located abroad, TWK*, is the sum of foreign-located debt and equity. The value of the latter is the discounted sum of foreign dividends net of foreign share issues.

1.2.2 Household Behavior

Households are represented as forward-looking and having perfect foresight. The treatment of domestic and foreign households is similar, although more detail is provided on the domestic side.

Consumption and Asset Choices

In each country, a representative, infinitely lived household solves a multilevel decision problem (table 1.2). Consider the domestic household. Its problem is to choose a path of consumption and a path of portfolio holdings. When domestic and foreign assets are imperfect substitutes and offer different expected returns, portfolio and consumption choices need to be coordinated since the choice of portfolio affects the overall rate of return to the household. One approach to this problem would be to incorporate risk explicitly. But the integration of portfolio choice and consumption demands in the face of risk and uncertainty presents difficult, unresolved theoretical issues, particularly when there are many time periods and many consumption goods.[14] Resolving these issues is beyond the scope of this paper. Moreover, risk may only partly explain the main empirical fact of interest: that households hold diversified portfolios despite sustained differences in rates of return.[15] In this investigation, we adopt an alternative approach. Our starting point is the observation that households exhibit strong home-country preference: assets from their own country often make up the bulk of their portfolios, even when rates of return

Table 1.2 Household Consumption Structure

Consumption Relation			Functional Form
U	$=$	$U(\bar{C}_t, \bar{C}_{t+1}, \ldots)$	Constant intertemporal elasticity of substitution
$\bar{C}_s$	$=$	$\bar{C}_s(C_s, A_s)$	Cobb-Douglas
C_s	$=$	$C_s(\bar{c}_{1,s}, \bar{c}_{2,s}, \ldots, \bar{c}_{m,s})$	Cobb-Douglas
A_s	$=$	$A_s(\alpha_s, 1 - \alpha_s)$	CES
$\bar{c}_{i,s}$	$=$	$\bar{c}(c_{i,s}, c^*_{i,s})$	CES

Note: U = intertemporal utility; C_s = overall consumption at time s; A_s = portfolio preference index at time s; $\bar{c}_{i,s}$ = consumption of composite consumer good i at time s; $c_{i,s}$ = consumption of domestically made consumer good i at time s; and $c^*_{i,s}$ = consumption of foreign-made consumer good i at time s.

on other-country assets are comparable or higher. In keeping with this observation, we posit a portfolio preference function that is consistent with the observed home-country preference yet can be embedded within a utility-maximizing framework that allows households to adjust asset shares in accordance with differences in rates of return.[16] (Below, we also report results using an alternative specification in which consumption and asset preferences are decoupled.) In each period t, the household maximizes a utility function of the form:

$$U = \sum_{s=t}^{\infty} (1 + \delta)^{t-s}(1 - \Omega)^{-1}(C_s^{\beta}A_s^{1-\beta})^{1-\Omega}, \tag{31}$$

where δ is the rate of time performance, Ω is the inverse of the intertemporal elasticity of substitution, C is an index of overall consumption in a given period, and A is a function of the household's asset holdings. We specialize A to a constant elasticity of substitution (CES) function of α and $1 - \alpha$, the shares of the household's portfolio devoted to domestic and foreign assets:[17]

$$A = k[\alpha_0^{1-\rho}\alpha^{\rho} + (1 - \alpha_0)^{1-\rho}(1 - \alpha)^{\rho}]^{1/\rho}. \tag{32}$$

The household maximizes utility subject to the wealth accumulation condition:

$$WK_{t+1} - WK_t = r_t\alpha_tWK_t + r_t^*(1 - \alpha_t)WK_t + YL_t - \bar{p}_tC_t, \tag{33}$$

where WK is the total nonhuman wealth owned by the household, r and r^* are the annual after-tax returns offered to the household on its holdings of domestic and foreign assets, YL is labor income net of all taxes and tranfers, and $\bar{p}$ is the price index for overall consumption.

The function $A(\cdot)$ summarizes the household's portfolio preferences: if $r = r^*$, households maximize utility by choosing the asset shares α_0 and $1 - \alpha_0$. When rates of return differ, however, maintaining the portfolio shares α_0 and $1 - \alpha_0$ has a cost in terms of a lower overall return than that which could be obtained if the household held more of the asset with the higher return. The household chooses the path of α that balances the rewards of approaching preferred shares against the costs in terms of a lower overall return on the portfolio.

The parameter ρ in the portfolio preference function is related to σ, the elasticity of substitution between asset shares ($\rho = 1 - 1/\sigma$). When $\sigma = 0$, households maintain shares α_0 and $1 - \alpha_0$ of domestic and foreign assets irrespective of differences in rates of return. As $\sigma \rightarrow \infty$, household behavior approaches the limiting case of perfect substitutability, where the slightest difference in returns leads households to hold only the asset offering the highest return.[18]

The Hamiltonian for the household's intertemporal problem is given by

$$H = (1 + \delta)^{1-t}(1 - \Omega)^{-1}(C_t^{\beta}A_t^{1-\beta})^{1-\Omega} + \lambda_t(1 + \delta)^{1-t}[(r_t^* - v_t\alpha_t)\mathrm{WK}_t + \mathrm{YL}_t - \bar{p}_tC_t], \tag{34}$$

where $v_t = r_t^* - r_t$. Differentiating with respect to the control variables α and C yields the first-order conditions

$$\beta(C_t^{\beta}A_t^{1-\beta})^{-\Omega}C_t^{\beta-1}A_t^{1-\beta} = \lambda_t\bar{p}_t\ , \tag{35}$$

$$(1 - \beta)(C_t^{\beta}A_t^{1-\beta})^{-\Omega}C_t^{\beta}A_t^{-\beta}A_t' = \lambda_t v_t \mathrm{WK}_t\ . \tag{36}$$

Once λ, the marginal utility of wealth, is known, α and C can be identified from these two first-order conditions. Differentiating the Hamiltonian with respect to the state variable WK yields the equation of motion for λ:

$$\frac{\lambda_{t+1}}{\lambda_t} = \frac{1 + \delta}{1 + \bar{r}_t}, \tag{37}$$

where $\bar{r}_t$ is the average portfolio return, equal to $\alpha_t r_t + (1 - \alpha_t)r_t^*$. We identify λ in each period by first solving for its steady-state value and then applying equation (37) for transition years.

The domestic (foreign) household's total nonhuman wealth, WK (WK*), is related to industry liabilities through the following relations:

$$\mathrm{TWK} = \sum_{i=1}^{10} (V_i + \mathrm{DEBT}_i). \tag{38}$$

$$\mathrm{TWK}^* = V^* + \mathrm{DEBT}^*, \tag{39}$$

Where TWK and TWK* denote total nonhuman wealth located at home and abroad, denominated in the respective currencies of each resident, as in section 1.1.1 above. Total nonhuman wealth of domestic and foreign residents, WK and WK*, can be expressed as

$$\mathrm{WK} = \gamma\mathrm{TWK} + (1 - \gamma^*)\mathrm{TWK}^*/e, \tag{40}$$

$$\mathrm{WK}^* = \gamma^*\ \mathrm{TWK}^* = (1 - \gamma)\mathrm{TWK} \cdot e, \tag{41}$$

where γ represents the proportion of the debt and equity of domestic firms held by domestic residents and γ^* expresses the proportion of the debt and equity of foreign firms held by foreigners, as in section 1.1.1 above. If households wish to maintain current asset proportions, then $\alpha = \gamma\mathrm{TWK}/\mathrm{WK}$, and $\alpha^* = \gamma^*\mathrm{TWK}^*/\mathrm{WK}^*$. When rates of return change, however, households immediately alter the composition of their portfolios. Thus, changes in asset holdings from period to period reflect both changes in the composition of portfolios and increases in portfolio size associated with household saving.

Each asset generally yields a different return to residents of different countries; this reflects anticipated exchange rate movements and features of tax systems that impose different rates according to the residence of the taxpayer. Let $\bar{r}$ and $\bar{r}^*$ represent average returns on the portfolios of domestic and foreign residents:

$$\bar{r} = \alpha r_{DD} + (1 - \alpha) r_{DF} , \tag{42}$$

$$\bar{r}^* = \alpha^* r_{FF} + (1 - \alpha^*) r_{FD} , \tag{43}$$

where r_{DD} and r_{DF} again are the returns expected by domestic residents on assets located domestically and in the foreign country, respectively; r_{FF} and r_{FD} are defined analogously.

The Composition of Current Consumption

For domestic households,[19] overall consumption, C, in each period is a Cobb-Douglas aggregate of the seventeen consumption goods in the model, implying that consumption spending is allocated across consumption goods in fixed expenditure shares. Our model incorporates imported consumer goods by treating each good $\bar{c}_i$ as a CES composite of domestic and foreign goods of type i. Suppressing subscripts, we express the CES composite as

$$\bar{c} = [\hat{\alpha}^{1-\hat{\rho}} c^{\hat{\rho}} + (1 - \hat{\alpha})^{1-\hat{\rho}} c^{*\hat{\rho}}]^{1/\hat{\rho}}, \tag{44}$$

where c is the quantity of the domestic consumption good, c^* is the quantity of the foreign consumption good, and $\hat{\alpha}$ and $\hat{\rho}$ are parameters. The parameter $\hat{\rho}$ is related to the elasticity of the substitution, $\hat{\sigma}$, according to

$$\hat{\rho} = \frac{\hat{\sigma} - 1}{\hat{\sigma}} . \tag{45}$$

Since $\bar{c}$ $(\cdot)$ is homothetic, the ratio of domestic and foreign goods in the composite is independent of its level. Households select the optimal mix of domestic and foreign goods to minimize the cost per unit of composite.

1.2.3 Government Sectors

The domestic economy government is the same as in Goulder and Summers (1989), to which the reader is referred for details. It has three functions: collecting taxes, distributing transfers, and purchasing goods and services.

The model incorporates each of the major taxes in the United States, as in table 1.3. It includes features of the U.S. tax code that impose different effective rates on new and old capital; the explicit treatment of profits taxes, investment tax credits, and capital gains taxes allows it to capture the effects of tax policy on investment and dividend payment decisions. The model also distinguishes economic from tax depreciation.

Table 1.3 Model Treatment of Taxes

Tax		Treatment in Model
1.	Corporate income tax	Ad valorem tax on profits by industry; bond interest payments are expensed
2.	Property tax and corporate franchise taxes	Ad valorem tax on capital stocks by industry
3.	Investment tax credits	Ad valorem subsidy to investment by industry
4.	Depreciation deductions	Tax credit used on the value of depreciable capital stock, tax depreciation rate, and corporate income tax rate
5.	Contributions to social security, unemployment insurance, and workmen's compensation	Ad valorem tax on the use of labor services by industry
6.	Motor vehicles tax	Ad valorem tax on the use of motor vehicles by industry
7.	Excise taxes, other indirect business taxes, and nontax payments to government	Ad valorem taxes on output of producer goods
8.	Retail sales taxes	Ad valorem tax on purchases of consumer goods
9.	Personal income taxes (including state and local)	Linear function of labor and capital income
10.	Social security benefits, unemployment compensation, and other transfers	Lump-sum income transfer constituting a fixed share of overall government spending

The level of government spending (transfers plus purchases) is exogenous. Transfers and purchases each represent a fixed share of overall spending. Purchases fall onto specific producer goods in fixed expenditure shares.

Since the model exhibits steady-state growth in the base case, overall real government spending must increase at that steady-state growth rate, g. In the base case, the government budget balances in each period. In revised-case simulations, real government spending is fixed at the same levels as in the base case; budget balance is maintained through lump-sum adjustments to personal income taxes.[20]

The foreign government performs the same functions and has the same tax instruments as the domestic economy government, although individual industries are not distinguished.

1.2.4 Imports and Exports

Import demands consist of the demands for imported intermediate goods by U.S. producers and for imported consumer goods by U.S. consumers. Foreign producers require the same price (after conversion to foreign currency) for goods sold in the United States as for goods sold locally. These prices adjust to clear the market for each foreign good.

Foreign demands for U.S. exports depend on the value of overall foreign output and on the price of exports relative to foreign goods:

$$E_i = E_{0i} \cdot (Y^*/\bar{p}^*) \cdot \left(\frac{p_{Ei} \cdot e}{\bar{p}^*}\right)^{-\epsilon_i}. \tag{46}$$

Here, E_i is the quantity demanded of the ith U.S. export, E_{0i} is the original expenditure share (at prices of unity), Y^* is foreign GNP, $\bar{p}^*$ is the foreign GNP price index, P_{Ei} is the export price in dollars, and ϵ_i is the export price elasticity of demand.

1.3 Solving the Model

Equilibrium must satisfy two sets of conditions. Intratemporal equilibrium requires that, given expectations of future variables, current supplies and demands balance in each period. Intertemporal equilibrium requires that expectations conform to the values realized in later periods.

At each point in time, expectations are embedded within the current period values of "forward" variables. For the domestic economy, the forward variables are as follows:

V_i = the equity value of firm i ($i = 1, \ldots, N$);
Q_i = the tax-adjusted q for firm i ($i = 1, \ldots, N$);
Z_i = the present value of depreciation allowances on a dollar of new investment ($i = 1, \ldots, N$);
B_i = the present value of depreciation allowances on existing capital ($i = 1, \ldots, N$); and
λ = the shadow value of the domestic household's wealth.

The V_i's and B_i's can be expressed in terms of the Q_i's, Z_i's, and current values (see Goulder and Summers 1989). Hence, expectations for the domestic economy are fully summarized by the values of Q and Z for each industry and the value of λ.

The forward variables for the foreign economy are:

V^* = the equity value of the foreign firm;
Q^* = the tax-adjusted q for the foreign firm; and
λ^* = the shadow value of the foreign household's wealth.

It is possible to derive explicit relations of the form (see eq. 37; and Goulder and Summers 1989, app.):

$$\begin{aligned} Q_{it} &= Q_{it}(\Psi_{1it}, V^E_{i,t+1}), \quad (i = 1, \ldots, N), \\ Z_{it} &= Z_{it}(\Psi_{2it}, Z^E_{i,t+1}), \quad (i = 1, \ldots, N), \end{aligned} \tag{47}$$

$$\lambda_t = \lambda_t(\Psi_{3t}, \lambda^E_{t+1}),$$
$$Q^*_t = Q^*_t(\Psi_{4t}, V^{*E}_{t+1}),$$
$$\lambda^*_t = \lambda^*_t(\Psi_{5t}, \lambda^{*E}_{t+1}),$$

where the variables Ψ_{jt} ($j = 1, \ldots, 5$) refer to prices and quantities observed in period t and V^E_{t+1}, Z^E_{t+1}, λ^E_{t+1}, V^{*E}_{t+1}, and λ^{*E}_{t+1} refer to the values, expected in period t, for V, Z, λ, V^*, and λ^* in the next period. We refer to the variables with E superscripts as "lead" variables. We also employ e^E, a lead variable for the exchange rate.

Solution proceeds in two steps. First, we posit values for the lead variables for $t = 2, 3, \ldots, T + 1$, where T is the last period simulated. The first-level, intratemporal equilibrium problem is to calculate a general equilibrium solution in every period conditional on these guesses. The second-level, intertemporal equilibrium problem is to solve for the correct values for the lead variables.

1.3.1 Intratemporal Equilibrium

Intratemporal equilibrium requires that, in each country and at each period of time, (1) the demand for labor equal its supply, (2) the demand for output from each industry equal its supply, (3) total external borrowing by firms equal total saving by residents of the given country plus the net capital inflow to that country, and (4) government revenues equal government spending. These requirements imply a total of seventeen equilibrium conditions (see table 1.4): two for the domestic and foreign labor markets, ten for the domestic product market, one for the foreign product market, two for the domestic and foreign loanable funds markets, and two for the domestic and

Table 1.4 Summary of Equilibrium Conditions

Intratemporal equilibrium conditions:	
Labor demand = labor supply	In each country
Gross output demand = gross output supply	For each domestic industry and the foreign industry
Government spending = government revenue	In each country
Total industry borrowing = domestic saving + net capital inflow	In each country
Intertemporal equilibrium conditions:	
$V^E_t = V_t$, $t = 2, 3, \ldots, T$;	$V^E_{T+1} = V_{ss}$
$Z^E_t = Z_t$, $t = 2, 3, \ldots, T$;	$Z^E_{T+1} = Z_{ss}$
$V^{*E}_t = V^*_t$, $t = 2, 3, \ldots, T$;	$V^{*E}_{T+1} = V^*_{ss}$
$\lambda^E_t = \lambda_t$, $t = 2, 3, \ldots, T$;	$\lambda^E_{T+1} = \lambda_{ss}$
$\lambda^{*E}_t = \lambda^*_t$, $t = 2, 3, \ldots, T$;	$\lambda^{*E}_{T+1} = \lambda^*_{ss}$
$e^E_t = e_t$, $t = 2, 3, \ldots, T$;	$e^E_{T+1} = e_{ss}$

foreign governments' budget balance. It suffices to solve for sixteen equilibrium conditions as the remaining one will then be satisfied by Walras's law. To obtain the intratemporal equilibrium, we employ the Powell (1970) algorithm, which tries alternative values for sixteen "prices": the ten domestic output prices, the foreign output price, the domestic and foreign gross interest rates, the nominal exchange rate, and the domestic and foreign tax scalars (which control the lump-sum tax adjustments necessary to bring about budget balance in each country). The nominal wage in each country (in its own currency) is exogenous and assumed to grow at a rate of 6 percent. The nominal exchange rate serves to bring nominal magnitudes at home and abroad into line (see n. 8 above).

In Appendix A, we outline the method for deriving excess demands in each period from the given set of prices tried by the intratemporal solution algorithm.

Once the intratemporal equilibrium is obtained for the first period, we augment the capital stocks of each industry on the basis of net investment and increment the total supplies of domestic and foreign labor by their growth rate, g. We then repeat the equilibrium calculations for the next period. In this manner, we solve for every period in the simulation interval.

1.3.2 Intertemporal Equilibrium

Perfect foresight requires that expectations conform to the values that ultimately obtain. To meet this requirement, we repeatedly solve the model forward, each time revising the expectations (embedded in the lead variables) that affect each intratemporal equilibrium. Appendix B describes our procedure for obtaining the perfect foresight expectations.

1.4 Data and Parameters

1.4.1 Stocks and Flows

We combine information from different sources to form a 1983 benchmark data set. Much of the benchmark data is drawn from the general equilibrium data set recently assembled by Scholz (1987). The Scholz data include information on production (final demand vectors of consumption, investment, government spending, imports, and exports by producer good; matrix of input-output transactions; vectors of labor inputs by industry; labor taxes and intermediate input taxes by industry; and production function elasticities by industry) and on consumption (matrix of expenditures on consumer goods by household; vector of savings by household; transition matrix between producer [industry] and consumer goods; and vectors of income taxes paid, sales taxes paid, marginal tax rates, and transfers received by the household).

We have supplemented these data with information on capital taxes and the financial behavior of firms, including capital gains tax rates, tax depreciation rates, dividend-payout and debt-capital ratios, and equity risk premia.[21] We have also added information on capital stocks by industry obtained from the *Survey of Current Business*. Base case values for tax rates and behavioral parameters are displayed in table 1.5. Tax rates for the foreign sector are set equal to the weighted average of the rates applying in the United States.[22]

Since domestic firms distinguish between domestic and foreign intermediate goods in production, it is necessary to employ a domestic and foreign input-output matrix describing the use of domestic and foreign-made inputs in each industry. The relations among the domestic and foreign input-output matrices, the components of final demand, and value added are indicated in figure 1.1.

Since the U.S. government does not produce a foreign input-output matrix, we constructed one. This involved categorizing imports according to their end use (intermediate use, consumption, or investment).[23]

In the benchmark data set, we impose an initial value for γ, the share of domestic nonhuman wealth owned by domestic residents, obtained from information on foreign ownership of U.S. assets and total domestically

Table 1.5 Benchmark Values for Industry Tax and Behavioral Parameters

Industry	Rate of Economic Depreciation (δ^R)	Rate of Tax Depreciation (δ^T)	Equity Risk Premium (η)	Debt-Capital Ratio (b)
1. Agriculture and mining	.010	.203	.139	.179
2. Crude petroleum and refining	.051	.120	.087	.181
3. Construction	.156	.220	.091	.080
4. Textiles, apparel, and leather	.078	.131	.111	.435
5. Metals	.082	.130	.084	.339
6. Machinery	.094	.140	.084	.365
7. Motor vehicles	.109	.161	.089	.255
8. Miscellaneous manufacturing	.087	.180	.083	.220
9. Services	.067	.124	.092	.527
10. Housing	.010	.070	.100	.502

Scalars:

Growth rate of effective labor services (steady-stage real growth rate)	(g)	.03
Growth rate of nominal wages (steady-state inflation rate)	(π_0)	.06
Corporate profits tax rate	(τ)	.34
Capital gains tax rate	(κ)	.05
Marginal income tax rate	(θ)	.285
Nominal interest rate	(i)	.071

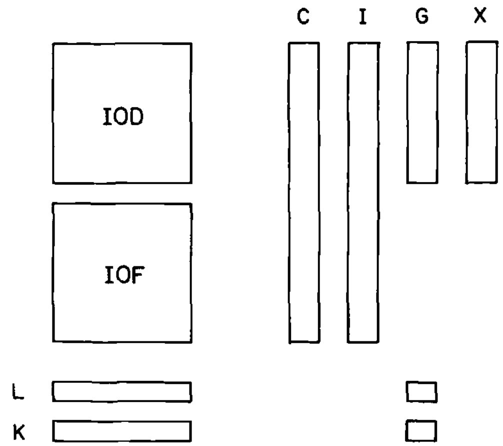

Fig. 1.1 Relations among final demand, intermediate input use, and value added

Note: In the benchmark data set, government purchases of imports are zero, and foreign imports are not reexported. Hence, the *G* and *X* vectors do not extend into the imports rows.

C = Personal consumption expenditures on domestic and foreign goods
I = Expenditures on domestic and foreign capital goods
G = Government purchases of domestic goods, labor services, and capital services
X = Exports of domestic goods
IOD = Domestic input-output matrix—domestic intermediate goods used by domestic industry
IOF = Foreign input-output matrix—foreign intermediate goods used by domestic industry
L = Labor services inputs
K = Capital services inputs

located assets from the *Survey of Current Business* and Federal Reserve balance sheets. We also impose a value for the U.S. share of global wealth based on a comparison of GDP in the United States and other non-Communist countries. With this information we derive (as discussed below) the benchmark level of foreign wealth and the benchmark portfolio shares.

1.4.2 Parameters

Parameterizing the model involves selecting certain parameters from outside sources and deriving the remainder from restrictions posed by two sorts of requirements:

Replication Requirement. In the base case, the model must generate an equilibrium solution with values matching those of the benchmark data set.

Balanced Growth Requirement. In the base case, the model must generate a steady-state growth path.

First, we specify the exogenous growth rate of effective labor, g, and the exogenous growth rate of nominal wages, π_0. The rate g determines the steady-state real growth rate of the economy and π_0 the steady-state inflation rate. These variables take the values .03 and .06, respectively.

In our central case simulation, we employ a value of 0.06 for time preference (δ) and a value of 0.5 for the intertemporal elasticity of substitution in consumption ($1/\Omega$).

In the steady state, the rate of gross investment, I/K, in each industry must satisfy

$$I/K = g + \delta^R, \tag{48}$$

where subscripts have been suppressed for convenience. The values for K, g, and δ^R are contained in the benchmark data set. We derive the initial level of investment in each industry from equation (48). A similar procedure determines initial values for the depreciable capital stock, KDEP.

We derive the benchmark values of firm debt (DEBT) and equity (V) from data on capital stocks, tax rates, and nominal interest rates.[24] Summing across domestic industries yields TWK, total domestically generated nonhuman wealth. Total nonhuman wealth generated abroad, TWK*, is a given multiple, m, of TWK.[25] Using TWK* and the foreign interest rate i^*, we derive foreign capital incomes.

The procedure is similar for human wealth. From data on labor incomes, taxes, and transfers, we calculate domestic human wealth, TWH, as the present value of the stream of after-tax labor and transfer income. Foreign human wealth, TWH*, is set at $m \cdot$ TWH.

From γ and the requirement of capital account balance in the base case, we derive γ^* and the initial values for the portfolio shares α and α^*.

In the benchmark equilibrium, before-tax nominal interest rates are equal at home and abroad. Those nominal interest rates must be consistent with the requirement that domestic investment equal national saving plus the net capital inflow. This condition can be evaluated only after wealth levels and portfolio shares have been determined, yet these levels and shares themselves depend on the assumed value for the interest rate. Hence, it is necessary to iterate to obtain the benchmark value for the nominal interest rate.

Table 1.6 displays the base case (calibrated) values for the principal variables of the model.

1.5 Simulation Results

The "base case" equilibrium path is the standard against which the effects of policy changes are measured. As mentioned above, the U.S. and foreign economies display steady-state growth in the base case at an annual rate of 3

Table 1.6 Benchmark Values for Income and Wealth

	U.S. Firms	Foreign Firms
Wealth:		
Human and transfer wealth	27,606	64,414
Nonhuman wealth:	8,139	18,992
Owned by U.S. households	7,407	733
Owned by foreign households	733	18,259
Income and tax payments:		
Labor income payments:	1,842	4,297
To U.S. households	1,842	0
To foreign households	0	4,297
Capital income payments:	464	1,083
To U.S. households	422	42
To foreign households	42	1,041
Indirect taxes paid	298	696
Investment expenditure and financing:		
Investment expenditure	620	1,446
Investment financing:		
Retained earnings	453	1,057
Domestic household saving	152	15
Foreign household saving	15	374

Note: All values are in billions of 1983 dollars.

percent. We perform simulations spanning an interval of seventy-five years ($T = 75$), with the equilibria spaced one year apart. Following a policy change, both economies approach the new steady state quite closely well before the seventy-fifth year, and using larger values for T does not significantly affect the simulation results.

1.5.1 Promoting Savings through a Consumption Tax

Our savings-promoting policy combines a 4 percentage point increase in taxes on consumption (sales and excise taxes, most of which are in the 5–10 percent range initially) with a compensating reduction in domestic households' marginal income tax rates from 0.285 to 0.256. The policy change is treated as unanticipated and takes effect in the first period. It is approximately revenue neutral over the long term: the present value of the stream of changes in government revenue is approximately zero.[26] It encourages saving by raising the after-tax rate of return.

No Mobility

We first examine the effects of this policy change in the absence of internationally mobile financial capital. In this scenario, the portfolios of domestic and foreign households contain only the assets of the country of residence, and thus households have no concern for rates of return offered on assets located in the other country. The effect of the policy change is to raise the after-tax return for domestic households and generate additional saving, allowing a drop in the equilibrium domestic gross interest rate. The lower interest rate implies an increase in fixed investment of 1.0 percent relative to the base case in the first period, as indicated in table 1.7. Over time, the rise in the capital intensity of the economy implies a lower marginal product of capital and a lower value of Q for any given interest rate; thus, the rate of investment falls, although the level of investment remains higher than in the base case because of the higher capital stock. In the new steady state, the rate of investment in each industry returns to its long-run value, while aggregate investment exceeds that of the base case (for corresponding years) by 1.4 percent.

In this scenario, the effects on imports and exports are minor in both the short and the long run. Since capital is internationally immobile, there is no capital account—a potentially important channel for transmitting effects on merchandise trade through its effect on the exchange rate. In the short run, real exports are not significantly affected by the policy change. Over the long term, the higher capital intensity and productiveness of the U.S. economy imply higher real output and incomes; this yields somewhat higher demands for foreign intermediate and final goods and a slightly increased volume of international trade. In the new steady state, real exports are approximately 0.4 percent higher than in the base case.

Mobility

The same initiative produces quite different effects once capital mobility is introduced. The differences are most easily seen by comparing the columns of table 1.7, which vary the substitutability of domestic and foreign assets.

We focus on the results of our central mobility case, which employs a value of 1.0 for σ. As before, the effect of the policy change is to raise the after-tax return to domestic households. We model the U.S. and foreign individual income tax systems as residence based: households pay capital income to their own governments, regardless of where the capital income originated.[27] This implies that for domestic households the new policy raises after-tax returns on savings invested at home and abroad. Thus, the policy change has no first-order effect on the international allocation of their (increased) savings. For foreign households, the change in policy does not affect the wedge between before- and after-tax returns since their marginal tax rates do not change. The asymmetry in the changes in marginal rates implies significant adjustments in the capital account.

In the central mobility case, domestic households increase their saving by 5.1 percent in the initial period. Since the largest share of domestic portfolios consists of domestic assets, and since the new policy has relatively little effect on the desired portfolio composition, the bulk of the increase in domestic household saving is directed toward domestic assets. This depresses the U.S. before-tax nominal interest rate, which falls initially from 7.1 to 6.8 percent.

Table 1.7 Effects of Savings Subsidy under Alternative Asset Mobility and Asset Substitutability Assumptions

	No Mobility			Mobility (σ = .2)			Mobility (σ = 1)			Mobility (σ = 5)		
	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State
Nominal exchange rate (foreign currency/$)	.996	.998	1.002	.990	.997	1.006	.990	.995	1.007	.987	.988	1.014
Saving by U.S. households:	2.72	1.88	2.13	5.98	3.48	2.03	5.09	2.92	2.21	5.01	3.57	3.09
U.S. asset accumulation	2.72	1.88	2.13	5.08	2.94	2.03	3.57	2.06	2.04	1.83	1.54	2.06
Foreign asset accumulation	.00	.00	.00	15.13	8.93	2.02	20.54	11.63	3.85	44.69	24.03	13.53
Home asset accumulation share[a]	1.0	1.0	1.0	.902	.905	.910	.897	.902	.909	.878	.892	.901
Saving by foreign households:	.01	.01	.01	−1.02	−.66	−.09	−1.06	−.81	−.21	−1.46	−1.51	−.83
U.S. asset accumulation	.00	.00	.00	−10.57	−5.31	.29	−3.37	−6.41	−.52	10.13	−11.33	−4.61
Foreign asset accumulation	.01	.01	.01	−.80	−.47	−.11	−.97	−.59	−.20	−1.93	−1.12	−.68
Home asset accumulation share[a]	1.0	1.0	1.0	.965	.963	.961	.962	.964	.962	.957	.965	.963
Balance of payments (levels):[b]												
Capital account balance	0	0	0	−3,168	−2,094	−255	−3,494	−2,651	−670	−5,035	−5,213	−2,854
Trade balance	0	0	0	2,128	−14	−1,939	2,632	681	−2,689	4,295	2,739	−6,428
Net income flow	0	0	0	1,040	2,108	2,194	862	1,970	3,359	740	2,474	9,282
Real exports	.20	.33	.39	.71	.34	−.01	.75	.47	−.07	1.10	.87	−.93
Domestic investment	1.00	1.16	1.43	1.04	1.30	1.32	.75	.91	1.29	.42	.49	1.13
Domestic consumption	−.06	.06	.19	−.26	.02	.33	−.10	.10	.39	−.04	.10	.65

Note: All values express percentage changes from the base case, except in the rows corresponding to the exchange rate, accumulation shares, and balance of payments components.

[a]Ratio of home asset accumulation to total asset accumulation. In the mobility scenarios, the base case values for the accumulation shares are .910 and .961 for domestic and foreign residents, respectively.

[b]All balance of payments items in millions of 1983 dollars. Figures are normalized to abstract from the long-run (steady-state) growth of the economy.

[c]Investment percentages may differ from personal saving percentages because of retained earnings and investment tax credits used to finance investment.

Because foreigners' marginal tax rates remain unchanged, the fall in before-tax interest rates in the United States leads to similar reductions in the after-tax returns they receive from U.S. assets. This implies a lower average return on foreigners' portfolios and lower overall foreign saving, which falls by approximately 1 percent on impact. Much of the reduction takes the form of reduced accumulation of U.S. assets; in the first year, inflows of foreign capital to the United States fall by 3.4 percent from $15.0 billion (1983 dollars) in the base case to $14.5 billion in the policy change simulation. But the increase in saving by domestic households more than offsets the decrease in capital inflows from abroad, and total saving (domestic saving plus the net capital inflow) increases, as shown in figure 1.2.

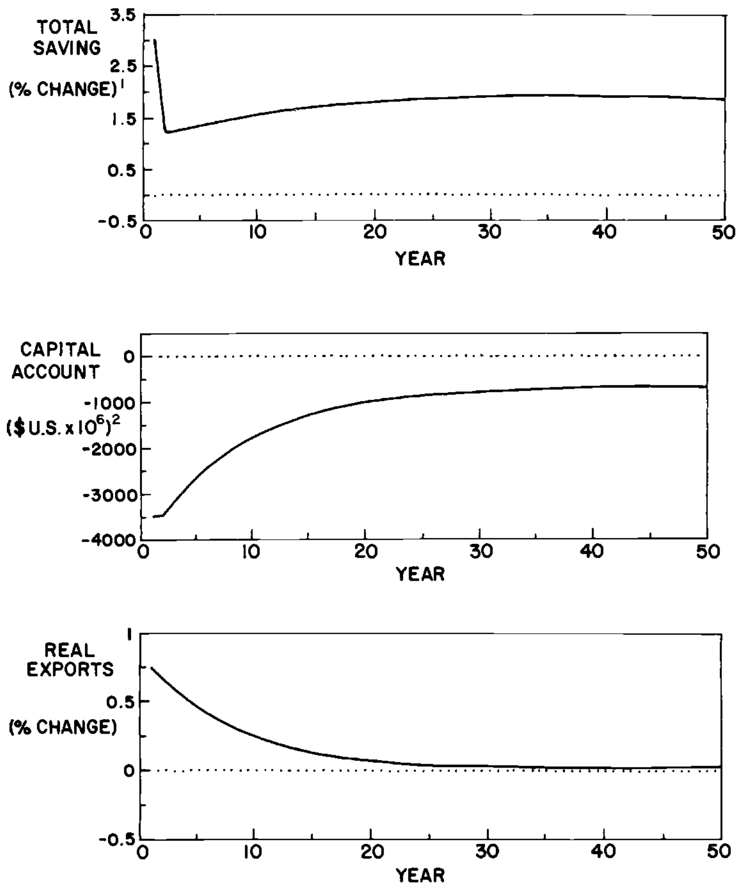

Fig. 1.2 Dynamic effects of a subsidy to saving

[1]Total saving is domestic saving plus net capital inflows.

[2]Capital account levels are normalized in each year by the factor $(1 + g)^t$, where g is the steady-state growth rate of the economy.

Increased purchases of foreign assets by domestic residents combine with reduced purchases of domestic assets by foreign residents to produce a capital account deficit since the capital account balance is zero in the base case. In the first year, the capital account balance is $\$-3.5$ billion. The capital account deficit puts downward pressure on the dollar, which depreciates by 1 percent initially. The cheaper dollar benefits export industries, whose output increases by 0.75 percent initially, and leads to a trade surplus.

Thus, the short-run effects on foreign trade of this savings-promoting initiative are different in the presence of international capital mobility. The differences stem from changes in the capital account and from subsequent effects on exchange rates.

Figure 1.2 illustrates that the long-term consequences of the savings subsidy differ substantially from the short-term effects. In the short and the medium term, domestic households enjoy a higher average return on their portfolios than do foreign households, reflecting the reduced marginal tax rates on their capital incomes. Income and savings by U.S. households grow faster than do those of foreigners. Much of the increase in saving by U.S. households is directed abroad. As a result, net income from abroad rises over time, putting upward pressure on the dollar and reducing export demands. Real exports decline (relative to the base case) over time. In the new steady state, real exports are 0.1 percent below the base case levels.

These results underscore the importance of accounting for international capital mobility in assessing the effects of savings-promoting policy on the performance of export (and import-competing) industries. Just as important, they indicate that such a policy's long-run consequences may be dramatically different from its effects in the short term.

To test the robustness of these results, we perform the same policy simulation for alternative values of σ. The essential pattern of effects is little different: whether σ equals 0.2, 1, or 5, the savings-promoting policy initially leads to increased accumulation of foreign assets by domestic households and reduced accumulation of domestic assets by foreign households. This implies a deficit on the capital account, a decline in the value of the dollar, and a rise in real exports in the short run.[28] In all three simulations, the position of exports is reversed in the long run as higher net income flows raise the value of the dollar. The magnitude of these effects increases as the value of σ grows. When σ is large, U.S. households' portfolio responses are greater: since they enjoy higher returns on assets located abroad than on those located at home, they respond to the policy change by devoting a larger share of their savings to purchases of new foreign assets.[29] As a result, the capital account deficit is larger the higher the value of σ, and exchange rate depreciation is more pronounced. Hence, export industries receive a larger initial boost.

1.5.2 Resurrecting Investment Tax Credits

We next investigate the effects of restoring investment tax credits (ITCs) to their effective rates prior to the Tax Reform Act of 1986. Since the credits apply only to equipment and not to structures, effective subsidy rates differ by industry according to the composition of each industry's physical capital in terms of structures and equipment. The ITC renewal is assumed to be unanticipated and to take effect in the first period. Where the previous policy affected incentives to save, this one affects incentives to invest.

No Mobility

The effect of implementing the ITC is to lower the effective cost of new capital to domestic industry and stimulate investment demand, as shown in table 1.8. Tax-adjusted q and investment rise everywhere except in the housing services industry, which enjoys little benefit from the policy change since its capital consists almost entirely of structures and its effective ITC rate is still zero. Heightened investment demands exert upward pressure on the domestic interest rate, which elicits an increase in saving by U.S. households of approximately 2.7 percent in the first year (see table 1.8).

The short-run effect on exports is very small. Eventually, however, real exports increase significantly relative to the base case, reflecting the fact that restoring ITCs raises the capital intensity of the economy over time, leading to higher incomes and output and a higher volume of trade. In the new steady state, real exports are approximately 2 percent higher than in the base case.

Mobility

Restoring the ITC produces quite different results in the presence of capital mobility, particularly in the short run. Again, we focus on the central mobility case ($\sigma = 1$).[30] As in the no-mobility scenario, the initial effect of the new policy is to stimulate investment demands and raise the domestic interest rate. Higher U.S. interest rates induce additional saving not only by U.S. residents but also by foreigners. Higher U.S. rates increase the relative attractiveness of assets located in the United States, leading to increased demands for these assets by U.S. and foreign residents. Total U.S. domestic saving (saving by U.S. nationals plus the net capital inflow) rises, reflecting the increase in global saving and the increase in the share of that saving devoted to the accumulation of U.S. assets. These changes in asset accumulation patterns imply a surplus on the U.S. capital account, which puts upward pressure on the dollar, making U.S. exports more expensive and reducing demand for U.S. exports by approximately 0.2 percent on impact.

Thus, restoring ITCs has different (though not exceptionally large) short-run implications for export industries once an allowance is made for international capital mobility.

In the presence of mobile capital, long-run effects differ significantly from short-run effects. The long-run effects reflect the fact that this policy change is source based, stimulating capital formation *in the United States* rather than globally (as in the savings-promotion policy). As a result, U.S. residents, who own capital located in the United States, experience faster income growth than do foreign residents. Their higher incomes bring about a rise in their

Table 1.8 Effects of Investment Tax Credits under Alternative Asset Mobility and Asset Substitutability Assumptions

	No Mobility			Mobility (σ = .2)			Mobility (σ = 1)			Mobility (σ = 5)		
	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State
Nominal exchange rate (foreign currency/$)	1.001	1.003	1.011	1.003	1.004	1.013	1.002	1.004	1.014	1.002	1.003	1.016
Saving by U.S. households:	1.29	.41	4.56	1.11	.98	3.95	1.50	1.06	4.00	1.43	1.34	4.29
U.S. asset accumulation	1.29	.41	4.56	1.10	.90	3.98	1.12	.97	3.97	.65	.92	3.99
Foreign asset accumulation	.00	.00	.00	1.22	1.82	3.70	5.29	1.98	4.29	9.28	5.66	7.31
Home asset accumulation share[a]	1.0	1.0	1.0	.910	.909	.910	.907	.909	.910	.903	.906	.907
Saving by foreign households:	−.02	−.01	.02	.18	−.11	−.07	.04	−.13	−.11	−.05	−.32	−.30
U.S. asset accumulation	.00	.00	.00	5.24	−1.08	.29	6.75	−1.21	−.01	8.72	−2.83	−1.32
Foreign asset accumulation	−.02	−.01	.02	−.03	−.07	−.08	−.23	−.09	−.12	−.40	−.22	−.26
Home asset accumulation share[a]	1.0	1.0	1.0	.959	.962	.961	.959	.962	.961	.958	.962	.962
Balance of payments (levels):[b]												
Capital account balance	0	0	0	585	−380	−290	214	−422	−427	−78	−1,199	−1,095
Trade balance	0	0	0	−1,196	−155	−1,266	−811	−178	−1,472	−472	409	−2,559
Net income flow	0	0	0	611	535	1,556	597	600	1,899	550	790	3,654
Real exports	−.07	.35	2.00	−.32	.33	1.66	−.24	.33	1.61	−.16	.44	1.38
Domestic investment[c]	2.71	3.36	7.35	2.86	3.46	6.86	2.86	3.47	6.84	2.76	3.40	6.79
Domestic consumption	−1.21	−.98	.76	−1.21	−.99	.83	−1.23	−.99	.84	−1.20	−1.02	.92

Note: All values express percentage changes from the base case, except in the rows corresponding to the exchange rate, accumulation shares, and balance of payments components.

[a]Ratio of home asset accumulation to total asset accumulation. In the mobility scenarios, the base case values for the accumulation shares are .910 and .961 for domestic and foreign residents, respectively.

[b]All balance of payments items in millions of 1983 dollars. Figures are normalized to abstract from the long-run (steady-state) growth of the economy.

[c]Investment percentages may differ from personal saving percentages because of retained earnings and investment tax credits used to finance investment.

accumulation of foreign assets relative to foreigners' accumulation of domestic assets, causing the capital account balance to fall and ultimately become negative. The rise in net interest income from abroad also reflects the increased accumulation of foreign assets by domestic residents. These considerable income flows help push up demands for dollars and cause the exchange rate to rise over time. Finally, higher domestic incomes imply faster growth in the demands for imports by domestic consumers and domestic industry, and the trade balance worsens over time.

The negative long-run trade balance is due to higher import volumes, not lower exports: in the long run, real exports exceed base case levels. This is a consequence both of a higher volume of trade and of lower real prices for U.S. goods. The ITC raises the capital intensity of the domestic economy, making labor more productive and lowering prices of U.S. goods to foreigners. The real exchange rate falls by 0.6 percent after ten years, despite the increase in the nominal exchange rate.[31] Thus, both income and relative price changes contribute to the revival of export demands. Figure 1.3 suggests that very little time is required for the initial adverse effects of the ITCs on exports to be reversed. In the long run, the real value of U.S. exports rises by 1.6 percent over base case levels.

These results underscore the importance of distinguishing the short- and long-run effects of growth-oriented tax policy. While confirming that there may be a conflict between investment promotion and the viability of export industries, our results suggest that the conflict may materialize only briefly.

1.5.3 Differences across Industries

So far our discussion of simulation results has focused on aggregate effects. The savings- and investment-promoting policies also yield very different effects across industries, differences our model is ideally suited to bring out.

Table 1.9 displays some of these differences. The first two panels of the table show the effects of the savings subsidy in the no-mobility case and the mobility case with $\sigma = 1$. In general, the savings subsidy boosts capital goods industries (construction, metals, machinery) relative to consumer goods industries in the short run. Over the longer term, the relative advantage of capital goods industries declines as the capital intensity of the U.S. economy rises and after-tax rates of return and rates of accumulation fall. Under the savings subsidy, the differences between the no-mobility and the mobility cases are relatively minor for industries that have little dependence on the export market. In contrast, for export-oriented industries, the mobility assumptions are important, as they affect the pattern of exports over time. Thus, in the short run the export-oriented agriculture and textiles industries fare better in the presence of mobility than in its absence; the reverse is the case in the long run.

The last two panels of table 1.9 consider the effects of the ITC renewal. Here, the differences across industries reflect mainly differences in the magnitude of investment credits across industries. The petroleum refining and

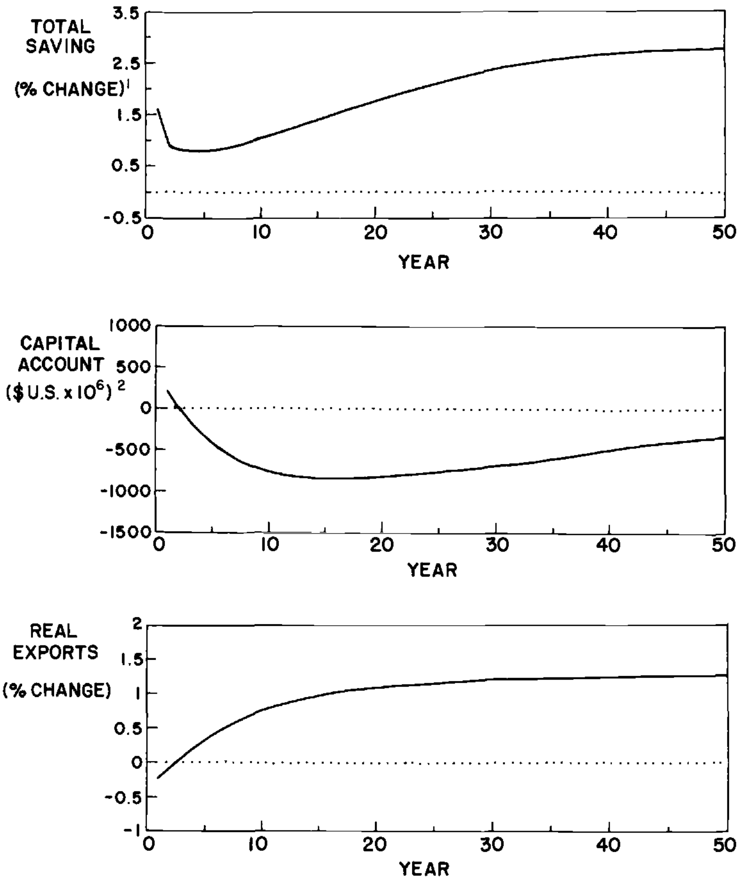

Fig. 1.3 Dynamic effects of restoring investment tax credits
[1]Total saving is domestic saving plus net capital inflows.
[2]Capital account levels are normalized in each year by the factor $(1 + g)^t$, where g is the steady-state growth rate of the economy

housing industries receive the smallest credits per unit of investment because the ratio of equipment to structures is low in these industries. In the first period, investment in housing declines slightly, and investment in petroleum refining increases by less than 3 percent, while investment in most other industries rises by between 5 and 7 percent. In the long run, investment in every industry exceeds base case levels, a consequence of the overall increase in productivity and incomes generated by the policy change.

1.5.4 Sensitivity Analysis

We test the robustness of our results further by considering the savings- and investment-promoting policies under alternative values for the parameter Ω,

Table 1.9 **Effects across Industries of Saving- and Investment-promoting Tax Changes (percentage changes from base case)**

	1 Agriculture and Mining			2 Crude Petroleum and Refining			3 Construction			4 Textiles, Apparel, and Leather			5 Metals		
	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State
Savings subsidy:															
1. No capital mobility:															
Investment	1.60	1.51	1.31	1.47	1.54	1.34	1.34	1.68	2.11	1.28	1.48	1.74	1.72	2.00	2.48
Employment	1.18	.19	−1.03	.74	.58	−0.14	.73	.83	1.01	.37	.39	.11	.55	.55	.39
Gross output	.20	.42	.57	.24	.45	0.77	.67	.81	1.07	.31	.39	.33	.41	.54	.74
Exports	−.29	.43	1.09	.01	.12	0.36	.22	.22	.11	.29	.34	.27	.19	.23	.20
2. Capital mobility (σ = 1):															
Investment	1.41	1.34	1.16	1.03	1.08	0.92	.98	1.37	1.89	1.02	1.20	1.50	1.39	1.62	1.97
Employment	1.42	.38	−1.07	1.23	.81	−0.36	.55	.65	.91	.62	.55	.04	.78	.56	.09
Gross output	.29	.43	.46	.43	.47	0.44	.51	.64	.96	.53	.51	.24	.61	.54	.41
Exports	.04	.44	.63	.23	.13	0.00	.66	.35	−.31	.91	.51	−.34	.61	.35	−.22
ITC renewal:															
1. No capital mobility:															
Investment	3.45	3.64	5.50	2.77	3.30	6.38	6.24	7.80	14.15	5.08	6.25	11.75	6.20	7.55	13.78
Employment	.61	−1.04	−2.58	−.56	−.51	−0.11	2.01	2.31	5.01	−1.28	−1.06	.38	.98	1.07	2.03
Gross output	−.17	.45	2.88	−.30	.25	3.87	1.80	2.33	5.48	−1.17	−.70	1.85	.65	1.19	3.94
Exports	−.33	1.09	3.81	.12	.27	1.62	−.09	.06	.73	.03	.32	1.70	−.12	.10	1.16
2. Capital mobility (σ = 1):															
Investment	3.50	3.66	5.24	2.95	3.41	5.81	6.72	8.28	13.37	5.17	6.33	11.28	6.63	7.95	12.88
Employment	.52	−1.06	−2.53	−.73	−.56	−0.15	2.14	2.39	4.66	−1.40	−1.09	.38	.94	1.08	1.75
Gross output	−.21	.46	2.74	−.36	.26	3.52	1.91	2.41	5.11	−1.28	−.72	1.80	.61	1.22	3.57
Exports	−.43	1.08	3.44	.05	.27	1.32	−.22	.04	.48	−.16	.28	1.30	−.25	.08	.89

(*continued*)

Table 1.9 (continued)

	6 Machinery			7 Motor Vehicles			8 Miscellaneous Manufacturing			9 Services			10 Housing		
	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State
Savings subsidy:															
1. No capital mobility:															
Investment	1.38	1.61	1.91	1.42	1.67	1.94	1.31	1.55	1.77	1.56	1.82	2.44	.45	.56	.68
Employment	.44	.43	.34	.64	.54	.16	.34	.36	.14	.29	.27	−.15	.23	.07	−.71
Gross output	.31	.43	.62	.44	.53	.56	.23	.37	.47	.18	.28	.33	−.26	−.01	.64
Exports	.28	.33	.27	.27	.32	.27	.21	.37	.44	.36	.35	.32	.00	.00	.00
2. Capital mobility ($\sigma = 1$):															
Investment	1.05	1.23	1.49	1.11	1.40	1.74	.99	1.26	1.57	1.30	1.57	2.25	.23	.34	.64
Employment	.64	.46	.10	.72	.60	.14	.41	.42	.12	.31	.33	−.08	.10	.12	−.47
Gross output	.49	.43	.35	.51	.56	.50	.30	.39	.41	.21	.31	.35	−.13	−.02	.61
Exports	.89	.50	−.33	.88	.49	−.32	.82	.52	−.17	1.03	.54	−.32	.00	.00	.00
ITC renewal:															
1. No capital mobility:															
Investment	5.69	6.87	11.73	5.13	6.35	11.64	5.77	6.90	11.70	6.64	8.21	16.30	−.60	−.60	.76
Employment	.76	.76	1.58	−.02	−.19	.41	−.18	−.16	.52	−.42	−.48	−.81	−2.01	−1.91	−1.70
Gross output	.41	.92	3.33	−.21	.27	2.86	−.31	.22	2.67	−.59	−.17	2.16	.29	−.10	.69
Exports	−.17	.20	1.70	−.08	.28	1.76	−.09	.47	2.36	.00	.25	2.24	.00	.00	.00
2. Capital mobility ($\sigma = 1$):															
Investment	5.99	7.14	11.00	5.39	6.59	11.08	6.01	7.09	11.17	6.94	8.46	15.59	−.55	−.60	.39
Employment	.72	.76	1.36	−.04	−.20	.38	−.20	−.17	.50	−.43	−.50	−.72	−2.03	−1.95	−1.40
Gross output	.37	.94	3.03	−.23	.29	2.73	−.34	.23	2.56	−.61	−.17	2.13	.27	−.08	.34
Exports	−.36	.17	1.30	−.27	.25	1.37	−.28	.45	1.94	−.20	.22	1.81	.00	.00	.00

whose inverse is the intertemporal elasticity of substitution in consumption. The simulations previously considered adopt a value of 0.5 for this elasticity ($\Omega = 2$). Table 1.10 displays results for these central case simulations as well as for simulations with values of 0.25 and 1.0 for this elasticity.

With a higher intertemporal consumption elasticity, the savings-promoting policy induces a larger increase in savings by U.S. households, a sharper drop in gross-of-tax U.S. interest rates, and a larger reduction in savings by foreign households. There is a larger increase in domestic households' accumulation of foreign assets and a larger decrease in foreign households' accumulation of domestic assets, implying larger capital account deficits initially and larger effects on exchange rates and real exports. Under all three values for the intertemporal elasticity, the pattern of effects over time is very similar: real exports rise in the short run but fall in the long run.

Restoring the ITC similarly has larger effects on domestic households' saving the larger the value of the intertemporal substitution elasticity. The pattern of effects on exports is similar across different values for this elasticity: in all simulations, the policy shock hurts exports initially but eventually leads to export volumes above base case levels.

We also consider both policies under an alternative model specification in which households' consumption and portfolio choices are independent. This alternative specification may appeal to those who prefer to leave asset preferences out of individuals' utility functions. Domestic households first choose portfolio shares according to

$$d\ \ln[\alpha/(1-\alpha)] = \sigma\ d\ \ln(r_{DD}/r_{DF}), \tag{49}$$

where σ is the elasticity of substitution between portfolio shares. They then choose consumption levels to maximize the utility function:

$$U = \sum_{s=t}^{\infty} (1+\delta)^{t-s}(1-\Omega)^{-1}C_s^{1-\Omega}, \tag{50}$$

where s is the current time period. The treatment of foreign households is analogous. The independence of consumption and portfolio choices in this specification is achieved at some cost: households' portfolio decisions do not stem from utility maximization but rather are based on the arbitrary rule of equation (49). Table 1.10 reveals that the pattern of results is very similar under the alternative specification: the savings-promoting policy again creates capital account deficits and stimulates exports in the short run while leading to capital account improvements and declines in real exports over the longer term. Similarly, restoring investment tax credits implies capital account surpluses and reduced export volumes in the short term and capital account deficits and higher export volumes in the long run.

Table 1.10 Effects under Alternative Model Specification and under Alternative Values for Intertemporal Substitution Elasticity

	.25[a]			.5[a,b]			1.0[a]			.5[a,c]		
	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State	Period 1	Period 5	Steady State
A. Savings Subsidy:												
Saving by U.S. households	4.25	2.72	2.61	5.09	2.92	2.21	5.24	2.83	2.10	6.86	4.35	1.97
Saving by foreign households	−.90	−.78	−.22	−1.06	−.81	−.21	−1.14	−.84	−.21	−1.39	−.97	−.22
Balance of payments (levels):[d]												
Capital account balance	−3,009	−2,640	−697	−3,494	−2,651	−670	−4,031	−2,991	−762	−4,695	−3,163	−704
Trade balance	2,338	923	−2,603	2,632	681	−2,689	3,094	828	−2,658	3,554	673	−2,516
Net income flow	671	1,717	3,300	862	1,970	3,359	937	2,163	3,420	1,141	2,490	3,220
Real exports	.71	.51	−.02	.75	.47	−.07	.84	.49	−.09	.94	.48	−.06
Domestic investment[e]	.66	.88	1.59	.75	.91	1.29	.66	.82	1.18	1.12	1.41	1.13
Domestic consumption	−.02	.10	.38	−.10	−.10	−.39	−.10	.11	.37	−.36	−.06	.34
B. Investment tax credit:												
Saving by U.S. households	.85	.78	5.76	1.50	1.06	4.00	1.88	1.12	3.33	.48	.037	4.64
Saving by foreign households	.14	−.10	−.19	.04	−.13	−.11	−.08	−.17	−.07	.16	−.11	−.14
Balance of payments (levels):[d]												
Capital account balance	598	−298	−691	214	−422	−427	−278	−603	−345	646	−374	−520
Trade balance	93	−170	−2,535	−811	−178	−1,472	−429	−162	−1,024	−1,088	−45	−1,955
Net income flow	505	468	3,226	597	600	1,899	707	765	1,369	442	419	2,475
Real exports	−.30	.30	1.53	−.24	.33	1.61	−.16	.34	1.65	−.29	.34	1.58
Domestic investment[e]	2.76	3.38	8.10	2.86	3.47	6.84	2.92	3.50	6.38	2.64	3.23	7.25
Domestic consumption	−1.18	−1.02	.86	−1.23	−.99	.84	−1.28	−.99	.80	−1.09	−.93	.91

Note: All values express percentage changes from the base case, except in rows corresponding to balance of payments components.

[a]Intertemporal substitution elasticity.

[b]Central case.

[c]Independent consumption and portfolio choice.

[d]Balance of payments items are in millions of 1983 dollars. Figures are normalized to abstract from the long-run (steady-state) growth of the economy.

[e]Investment percentages may differ from personal saving percentages because of retained earnings and investment tax credits used to finance investment.

1.6 Conclusions and Directions for Further Research

In this paper, we have presented a new framework for analyzing the effects of domestic and foreign policies on the U.S. economy. The model is unique in combining a disaggregated treatment of industry interactions, a detailed specification of personal and corporate taxes, a rigorous attention to adjustment dynamics, and an integrated treatment of current and capital account transactions. We use the model to analyze the short- and long-run effects of savings- and investment-promoting tax policies on the viability of export industries and find that in the presence of internationally mobile financial capital the effects of the two types of policies differ significantly from one another and change fundamentally over time.

In the absence of international capital mobility, investment- and savings-promoting policies each have insignificant short-run effects and favorable long-run effects on U.S. export industries. The long-run benefits reflect the fact that both policies raise the overall capital intensity of U.S. production, leading to an increase in productivity and incomes, to lower relative prices for U.S. goods, and to a higher overall volume of trade. In the presence of international capital mobility, the two types of policies differ from one another in their short- and long-term consequences. Restoring investment tax credits tends to hurt U.S. export industries in the short run but help them subsequently. The reverse is true of policies that subsidize saving. These differences reflect the very different implications of the two types of policies for the capital account of the balance of payments in the short run and the long run.

In future work, we intend to consider the normative implications of these policy alternatives; this study has concentrated on positive issues. We also plan to use the model to analyze the effects of recent changes in U.S. fiscal policy, of trade policy alternatives, and of a variety of industrial policies.

Appendix A:
Derivation of Excess Demands Based on Current Prices

Given a set of current prices, firms' optimal demands for labor and intermediate inputs can be determined. Given the interest rate and lead values for V and Z, one can derive the current values for Q and Z. From these one can derive investment, adjustment costs, demands for external funds, and the level of output of each industry.

On the consumer side, the current marginal utility of wealth λ_t (λ_t^*) can be calculated from the lead value, $\lambda_{t+1}^E(\lambda_{t+1}^{*E})$, and from the current interest rate, based on equation (37). Portfolio shares and overall consumption levels for each household can then be determined from current prices and the current value for λ, using the first-order conditions (35) and (36).

Current prices then dictate the allocation of current consumption expenditure to demands for specific consumption goods. Based on households' shares of dollar- and foreign-currency-denominated wealth and firms' dividend and interest payments, we derive households' capital incomes. Subtracting the value of consumption from households' total after-tax incomes yields household savings. Households devote their savings to the accumulation of domestic and foreign assets so as to attain the desired asset shares.

Demands by government depend only on current prices; lead variables are not employed here.

Appendix B:
Procedure for Obtaining Perfect Foresight Expectations

To solve for perfect foresight expectations, we first obtain the values for V, Z, λ, V^*, λ^*, and e that prevail in the new steady state after a policy change. In the base case, the steady-state values for these variables emerge from the calibration procedure discussed in section 1.4; in revised case simulations, a more complex simulation procedure is required.[32] We then assign the steady-state values as terminal values for the lead variables:

(B.1)
$$\begin{aligned} V^E_{T+1} &= V_{ss}, \\ Z^E_{T+1} &= Z_{ss}, \\ \lambda^E_{T+1} &= \lambda_{ss}, \\ V^{*E}_{T+1} &= V^*_{ss}, \\ \lambda^{*E}_{T+1} &= \lambda^*_{ss}, \\ e^E_{T+1} &= e_{ss}, \end{aligned}$$

where T is the last simulation period and the subscript ss denotes the value for a variable in the new steady state. Next, we conjecture an initial path for the lead variables.

We then solve the model for each within-period equilibrium given the initial path of the lead variables.[33] The within-period equilibrium solution provides a sequence of derived values: $V_1, V_2, \ldots, V_T; \ldots; e_1, e_2, \ldots, e_T$. We compare our conjectures with contemporaneous derived values updating the guesses in a Gauss-Seidel fashion. For example, we adjust the V^E path according to

(B.2)
$$V_t^{E(k+1)} = \mu V_t^{(k)} + (1 - \mu) V_t^{E(k)},$$

where k represents the iteration and μ is a parameter between zero and one. This procedure generally brings lead and realized values within 0.01 percent of one another within fifty iterations.

In this manner, we generate paths for the forward variables that have the appropriate slope across any two consecutive periods since agents have perfect foresight and impose the appropriate relation across periods in determining a current value on the basis of the corresponding lead variable. Each equilibrium path also has the appropriate level, as determined by the terminal values for each variable.

Notes

1. Slemrod (1988) offers an excellent summary of the implications of international capital mobility for the theory of capital income taxation.
2. See, e.g., Bovenberg (1989). The direction of the effects depends on the relative magnitudes of intratemporal elasticities of substitution between domestic and foreign goods in production and intertemporal elasticities of substitution in consumption. Giovannini (1987) shows that the relative size of these elasticities also determines the welfare consequences of savings- and investment-oriented policies under "small country" assumptions.
3. The framework here is essentially a two-country portfolio balance model, as analyzed, e.g., by Henderson and Rogoff (1982).
4. The basis for eqs. (5) and (6) is the arbitrage condition requiring that the return to owners of firms equal the rate offered on alternative assets. This is discussed in sec. 1.2 below.
5. Thus, the model offers considerably more industry detail than the Goulder-Summers (1989) model, which distinguishes five domestic industries.
6. This is the asset price approach to investment as developed in Summers (1981).
7. There is some debate as to what constitutes the best specification of firms' financing decisions. We adopt the "traditional" approach, according to which the marginal source of funds for investment is new share issues. For a discussion of this and other approaches, see Poterba and Summers (1985).
8. The nominal exchange rate brings nominal magnitudes at home and abroad into line. If all prices (other than the numeraire) are endogenous, the nominal exchange rate is superfluous. This is not the case if some prices (other than the numeraire) are fixed in nominal terms, however. In the model, domestic and foreign nominal wages are specified exogenously (and increase over time at a specified rate that determines the long-run inflation rate), permitting a role for the exchange rate.
9. Thus, the demands for foreign inputs derive from optimizing behavior, with the demand elasticities directly related to the substitution elasticities embedded in the production functions.
10. This transformation of producer goods into consumer goods is necessary because the categories for outputs from production data differ from the categories for goods from consumer expenditure data.
11. For an explicit derivation of this expression for V, see Poterba and Summers (1985).
12. This specification conforms to the "traditional" view of dividend behavior. Some empirical support for this view is presented in Poterba and Summers (1985). Further evidence comes from the large volume of share repurchases in recent years documented in Shoven (1987).
13. An alternative is external adjustment costs, according to which the costs of adjustment are borne through payments to an agent (e.g., an enterprise providing

installation services) external to the firm. For a discussion of these different approaches, see Mussa (1978).

14. The consumption-based capital asset pricing model (see, e.g., Duffie and Zame 1987) offers a potential approach to this problem, although the difficulties of empirical implementation are formidable.

15. Mehra and Prescott (1982) and Adler and Dumas (1983), e.g., argue that exchange rate risk provides only part of the explanation as to why households maintain internationally diversified portfolios.

16. The model is agnostic as regards the specific bases for households' portfolio preferences. One explanation might invoke risk considerations. Another might refer to different liquidity services offered by domestic and foreign assets. Poterba and Rotemberg (1983) refer to such services to justify including money in individual utility functions.

17. An alternative formulation would define A in terms of asset levels rather than shares. But, since asset stocks are used to finance future consumption, adding levels of asset holdings to the utility function would introduce an element of double-counting.

18. The value of σ thus critically influences the extent to which policy shocks or other exogenous changes will generate international capital flows.

19. We do not consider the foreign household here since different consumer goods are not distinguished in the foreign country.

20. This facilitates welfare evaluations since the household utility functions do not incorporate welfare derived from government-provided goods and services.

21. Our ten-sector disaggregation is not fully compatible with the disaggregation in the Scholz (1987) data. The Scholz data include metals, machinery, and miscellaneous manufacturing as one sector, while in our model these are three different sectors. We have split out the Scholz data on the basis of the shares of value added represented by each of the three components.

We have also added information pertaining to the housing industry. The Scholz data subsume housing within a real estate sector. To use these data in our model, the real estate sector data had to be divided into housing and other real estate. The weights used to disaggregate the real estate sector data were calculated on the basis of shares of value added in the 367 $\times$ 367 input-output matrix for 1977 published by the Department of Commerce (1984).

22. Ultimately, we intend to employ tax rates that more closely reflect effective rates abroad.

23. This information was obtained from the end-use import tables of the Bureau of the Census (U.S. Department of Commerce 1983) for merchandise trade and from McCulloch (1988) for trade in services. We applied it as follows:

a) From the end-use tables we obtained consumption and investment imports by type of good. For each import, total imports for intermediate use were then calculated by subtracting consumption and investment imports from total imports (of a given type) as given by Scholz (1987).

b) Domestic intermediates were calculated by subtracting foreign intermediates from total intermediate goods.

c) The foreign (domestic) input-output matrix was then calculated by multiplying each row of the total input-output matrix by the ratio of foreign (domestic) intermediate good to total intermediate goods. Thus, we assumed that, for each type of intermediate good, the ratio of domestic to foreign inputs of that type was the same across sectors. This assumption was necessary given the absence of information on the uses of intermediate imports by sectors.

24. The procedure is described in Goulder and Summers (1989).
25. The value of m is set at the ratio of foreign to U.S. GDP.
26. As described above, government budget balance is maintained in each year through lump-sum adjustments to domestic households' individual income tax obligations. The present value of these adjustments is approximately zero.
27. The U.S. individual tax system is primarily residence based; the corporate income tax has source-based elements, however, including the foreign tax credit.
28. The difference in returns offered to U.S. savers on domestic and foreign assets is relatively small, considerably smaller than the differences in gross interest rates across countries. This reflects the appreciation of the exchange rate, which, ceteris paribus, lowers the return to U.S. households on foreign assets.
29. The case of perfect substitutability is also of interest but poses special difficulties. Under residence-based taxation, such a scenario generally implies a corner solution: for one of the residents, the after-tax return will not be the same for the two assets, and thus the resident will hold only one of the two assets. If residents' tax rates differ, then if one of the residents faces equal after-tax returns on both assets, the other will not. See Slemrod (1988).
30. We also consider the effects of this policy change under alternative values for the asset elasticity of substitution, σ. As table 1.8 shows, the general pattern of results is quite consistent with those we discuss in the text.
31. In the short run, the rate of inflation in the United States falls below the long-run rate of 6 percent. The growth of foreign prices, however, is relatively unaffected by the policy change. In the long run, rates of inflation in the United States and abroad again are equal (at 6 percent), but the ratio of price levels is different from the ratio in the old steady state.
32. The procedure involves the solution of the general equilibrium model under steady-state constraints. In the constrained system, we iterate over capital stocks and ownership shares (γ and γ^*) as well as prices. Steady-state values for capital stocks and ownership shares have been attained when (1) the derived industry Q's are equal to the steady-state values and (2) the wealth accumulation patterns of households imply no changes in the ownership shares.
33. This technique is similar to the approach of Fair and Taylor (1983).

References

Adler, M., and B. Dumas. 1983. International portfolio choice and corporation finance: A synthesis. *Journal of Finance* 38:925–84.

Board of Governors of the Federal Reserve System. 1987. Balance sheets for the U.S. economy, 1947–86.

Bovenberg, A. L. 1986. Capital income taxation in growing open economies. *Journal of Public Economics* 31:347–76.

———. 1989. The effects of investment incentives on real exchange rates and trade flows. *American Economic Review*, in press.

Duffie, D., and W. Zame. 1987. The consumption-based capital asset pricing model. Stanford University. Mimeo.

Fair, R. C., and J. B. Taylor. 1983. Solution and maximum likelihood estimation of dynamic nonlinear rational expectation models. *Econometrica* 51(4):1169–85.

Giovannini, A. 1987. International capital mobility and tax evasion. NBER Working Paper no. 2460. Cambridge, Mass.: National Bureau of Economic Research.
Goulder, L. H., J. B. Shoven, and J. Whalley. 1983. Domestic tax policy and the foreign sector. In *Behavioral simulation methods in tax policy analysis*, ed. Martin Feldstein. Chicago: University of Chicago Press.
Goulder, L. H., and L. H. Summers. 1989. Tax policy, asset prices, and growth: A general equilibrium analysis. *Journal of Public Economics*, in press.
Henderson, D., and K. Rogoff. 1982. Negative net foreign asset positions and stability in a world portfolio balance model. *Journal of International Economics* 13:85–104.
Kouri, P. J. K. 1976. The exchange rate and the balance of payments in the short run and in the long run. *Scandinavian Journal of Economics* 78:280–304.
McCulloch, R. 1988. International competition in services. In *The United States in the world economy*, ed. Martin Feldstein. Chicago: University of Chicago Press.
McKibbin, W., and J. Sachs. 1986. Coordination of monetary and fiscal policies in the OECD. NBER Working Paper no. 1800. Cambridge, Mass.: National Bureau of Economic Research.
Mehra, R., and E. Prescott. 1982. A test of the intertemporal asset pricing model. Mimeo.
Mussa, M. 1978. Dynamic adjustment in a Heckscher-Ohlin-Samuelson model. *Journal of Political Economy* 86(5):775–91.
Mutti, J., and H. Grubert. 1985. The taxation of capital income in an open economy: The importance of resident-nonresident tax treatment. *Journal of Public Economics* 31:347–76.
Poterba, J. M., and J. J. Rotemberg. 1983. Money in the utility function: An empirical implementation. Massachusetts Institute of Technology. Mimeo.
Poterba, J. M., and L. H. Summers. 1985. The economic effects of dividend taxation. In *Recent advances in corporate finance*, ed. Edward T. Altman and Martin G. Subramanyam. Homewood, Ill.: Richard D. Irwin.
Powell, M. J. D. 1970. A hybrid method for nonlinear equations. In *Numerical methods for nonlinear algebraic equations*, ed. P. Rabinowitz. London: Gordon & Greach.
Sachs, J. 1981. The current account and macroeconomic adjustment in the 1970s. *Brookings Papers on Economic Activity*, no. 2:201–68.
Scholz, K. 1987. Documentation for the 1983 general equilibrium data set. Stanford University. Typescript.
Shoven, J. B. 1987. The tax consequences of share repurchases and other non-dividend cash payments to equity owners. In *Tax policy and the economy*, ed. L. H. Summers, vol. 1. Cambridge, Mass.: MIT Press.
Slemrod, J. 1988. Effects of taxation with international capital mobility. In *Uneasy compromise: Problems of a hybrid income-consumption tax*, ed. H. J. Aaron, H. Galper, and J. Pechman, 115–48. Washington, D.C.P Brookings Institution.
Summers, L. H. 1981. Taxation and corporate investment: A q-theory approach. *Brookings Papers on Economic Activity* (January), pp. 67–127.
———. 1988. Tax policy and international competitiveness. In *International aspects of fiscal policies*, ed. J. A. Frenkel. Chicago: University of Chicago Press.
U.S. Department of Commerce. 1984a. *Survey of Current Business* (August).
———. 1984b. *Survey of Current Business* (February).
———. Bureau of the Census. 1983. Highlights of U.S. export and import trade. Washington, D.C., December.
———. Bureau of Economic Analysis. 1984. *Detailed structure of the U.S. economy*. Washington, D.C.:

Comment David W. Roland-Holst

This paper makes a welcome contribution to computable general equilibrium (CGE) modeling because of its original treatment of international flow-of-funds activity. It should also be welcome in the present discussion of U.S. trade policy since a general equilibrium perspective and a more complete understanding of capital account dynamics are both essential to a comprehensive assessment of our competitive situation. My own experience is centered on modeling, so I shall focus my comments on methodology, beginning with three features of this work that I find attractive.

The authors (and Larry Summers, whose hand is apparent in part of this work) should be commended for substantially advancing the conventional treatment of savings and investment decisions. Using some recent microeconomics of savings-investment behavior as well as a set of convexifying techniques in the form of constant elasticity of substitution (CES) aggregations and Armington assumptions, the authors build a flow-of-funds component for their model that fully endogenizes interest rates and international capital flows. Not only are savings and investment more richly and rigorously specified in each period, but they are also placed in their necessary and proper context of intertemporal optimization, with some allowance for adjustment costs and uncertainty.

These innovations in flow-of-funds modeling lead to the main results of the paper. The authors experiment with different degrees of substitutability between domestic and foreign assets in domestic and foreign portfolios. The equilibria that arise with endogenous capital flows reveal a complex interplay between nominal and real influences on exchange rates. At first glance, the former are driven primarily by capital flows and the latter by demand. A closer look, however, reveals two more subtle forces at work. Capital flows lead to reverse nominal effects from profit income returning to foreign investors and to real effects from productivity changes in response to investment. The income and productivity effects of capital flows can be quite significant in the long run, and, as the authors point out, neglecting them can reverse one's conclusions about the advisability of fiscal reforms to promote domestic capital formation and competitiveness. To my mind, these results give a more refined understanding of exchange rates and capital accounts than the conventional stock-flow perspective, and they deserve further scrutiny.

Another novel feature of this model is its ingenious use of rational expectations in the solution process. Although the idea harks back to Bellman's original solution concepts for stochastic dynamic programming, explicit incorporation of rational expectations conditions in an iterative scheme provides a great expedient to solving dynamic general equilibrium models with "well-behaved" uncertainty.

David W. Roland-Holst is assistant professor of economics at Mills College.

With these and other virtues in mind, I look forward to seeing more simulation results from this model and its descendants. In the meantime, I would like to raise a few points for reflection.

This ten-sector model has been used to good advantage by the authors to study U.S. competitiveness in another paper in which they detail the composition of effects on U.S. industries of our recent trade history. However, I do wonder if the main conclusions of the present paper could have been obtained more simply and clearly from a one-sector model. The interplay between nominal and real effects is driven by financial flows, demand, and productivity changes, but I do not see an essential role here for the sectoral composition of production, consumption, or investment. By focusing these results on asset substitution elasticities in a simpler trade model, one might obtain an elegant intertemporal Marshall-Lerner condition to sort out the real and nominal exchange rate effects of capital account adjustments. Such a result is not available in the multisector case.

A final point concerns the monetary approach to the balance of payments. Computable general equilibrium model builders have tried for over a decade to incorporate monetary phonomena, without appreciable success. This represents one of the largest open problems for our field right now, and thus I do not single out the present paper for shortcomings in this respect.

In modeling economic adjustment, it would be desirable to accommodate the possibility of international payments imbalances if these are manifestations of intertemporal decisions rather than real disequilibria, that is, when they represent only differences between preferences for present and future consumption. Goulder and Eichengreen's CGE specification of asset holding and capital flows may ultimately provide a good vehicle for a neoclassical approach to the balance of payments, but its promise in this regard cannot be fulfilled, I think, without more direct treatment of monetary assets and institutions. Fortunately, a number of contributions have already been made along these lines that would be amenable to their framework. These include the lucid exposition of Dixit and Norman (1980) on this subject as well as a recent and ingenious approach to money holding by Drazen and Helpman (1987).

References

Dixit, A. K., and V. Norman. 1980. *Theory of international trade.* Cambridge: Cambridge University Press.

Drazen, A., and E. Helpman. Stabilization with exchange rate management. *Quarterly Journal of Economics* 102(4):835–55

Comment Wing Thye Woo

This is a very high-tech paper. Given the importance of the issue of international competitiveness, the use of sophisticated techniques needs no justification. Because policymakers need to know whether strong conclusions deriving from simple models would be supported or reversed by a more complicated model, Goulder and Eichengreen's dynamic computable general equilibrium model (CGE) model is an important contribution. This high-tech model supports most of the reasoning based on simpler models.

To focus attention on trade competitiveness, I will limit my discussion to Goulder and Eichengreen's conclusions about the short-run and steady-state effects of policy changes on export volume, trade account balance, and consumption. The workings of a large and complicated model are usually hard to figure out. The virtue of the Goulder-Eichengreen model is that it can be proxied very well by a very simple model, which I will call the skeletal model. The skeletal model is essentially the GDP identity with a modicum of economic theory thrown in. The main conclusions of the high-tech model are straightforward and intuitive; they come straight out of the intertemporal allocation of consumption spending in an open-economy setting. To be specific, of the twenty-four conclusions concerning the short-run and long-run behavior of the three variables under the four policy scenarios, the skeletal model is irreconciliable with the high-tech model in only one instance. What the high-tech component really does is to add much more detail to the analysis, for example, how the size and composition of the domestic portfolio respond to shifts in savings and investment incentives. Unfortunately, these details provide no additional guidance to policymakers.

Let me now substantiate the preceding statements.

Capital Is Immobile

Equation (1) is the definition of GDP, using the usual textbook notation:

$$C + S + T = Y = C + I + G + (X - M). \tag{1}$$

To convert the identity into a behavioral equation, I assume, as do Goulder and Eichengreen, a balanced budget,

$$T = G, \tag{2}$$

where G is exogenous, and zero capital mobility,

$$X - M = 0. \tag{3}$$

The policy experiments are implemented by changing the composition of a given amount of taxes (T) to distort private savings and investment behavior.

Wing Thye Woo is assistant professor of economics at the University of California, Davis.

Effect of a Savings Subsidy in the Short Run

The short run, by definition, is too short for changes in investment (I) to increase the productive capacity of the economy. The value of output (Y) is fixed. An increase in savings (S) with taxes (T) constant necessitates an equivalent fall in consumption (C). Even though the trade balance ($X - M$) is constant (zero), the components change. If consumption spending is more import intensive than investment spending, then imports would have to fall. The assumption in equation (3) would then force exports to decline by the same amount. Conversely, if consumption spending is less import intensive, then both imports and exports would rise. Hence, the skeletal model can explain why exports move in different directions in the old and new versions of the authors' table 1.7 (in the old version, which was presented at the conference but is not published in this volume, exports fell; they rise, however, in the new version).

Effect of a Savings Subsidy in the Long Run

Since the increased saving is fully translated into additional investments, the new steady state has a higher level of output. Consumption naturally rises, dragging imports up with it. Again because of the zero trade balance assumption, exports (being a residual quantity) rise too.

Effect of an Investment Tax Credit

In the short run, the rise in investment crowds out consumption given that G, $X - M$, and Y are fixed. The sign of the change in export is ambiguous, depending on the relative import intensiveness of consumption and investment spending.

The effects in the long run are the same as in the savings subsidy case because the same reasoning applies. For both the savings subsidy and the investment tax credit, the skeletal model and the high-tech model are observationally equivalent in that they both yield the same short-run and long-run response for exports, trade balance, and consumption.

Capital Is Mobile

Rewrite equation (1) as follows:

$$\text{(4)} \qquad \sum_0^{\infty}\left(\frac{1}{1+r}\right)^i (C_{t+1} + S_{t+i} + T_{t+i}) \equiv \sum_0^{\infty}\left(\frac{1}{1+r}\right)^i Y_{t+i}$$

$$\equiv \sum_0^{\infty}\left(\frac{1}{1+r}\right)^i [C_{t+i} + I_{t+i} + G_{t+i} + (X - M)_{t+i}].$$

Using the authors' assumption

$$\text{(5)} \qquad T_{t+i} = G_{t+i},$$

where G_{t+i} is constant for all i's, we get

$$(6)\quad \sum_{0}^{\infty}\left(\frac{1}{1+r}\right)^{i} I_{t+i} + \sum_{0}^{\infty}\left(\frac{1}{1+r}\right)^{i} (X - M)_{t+i} = \sum_{0}^{\infty}\left(\frac{1}{1+r}\right)^{i} S_{t+i}\,.$$

Now add two dashes of economic theory to equation (6). The first is that investment and savings decisions are arrived at on quite different bases. Investments are undertaken to maximize the wealth level and hence are determined solely by the marginal product of capital (f'), the rate of return on equities (r), and the adjustment cost. Savings are determined by the intertemporal allocation of consumption for a given level of wealth.

In a discrete time formulation with all transactions occurring at the beginning of each period, the stock of foreign assets at the beginning of time $t + 1$, F_{t+1}, is given by

$$(7)\qquad F_{t+1} = (1 + r)[F_t + (X - M)_t].$$

The second element of theory is to rule out Ponzi games in international borrowing, and the result is

$$(8)\qquad F_t = \sum_{0}^{\infty}\left(\frac{1}{1+r}\right)^{i} (X - M)_{t+i}\,.$$

For ease of exposition, I will assume that $F_t = 0$, to get

$$(9)\qquad (X - M)_t + \sum_{1}^{\infty}\left(\frac{1}{1+r}\right)^{i} (X - M)_{t+i} = 0.$$

Roughly speaking, equation (9) tells us that today's trade surplus is tomorrow's trade deficit. Note that, because of the discounting, the absolute size of today's trade surplus is smaller than the absolute size of tomorrow's trade deficit. Ceteris paribus, this means that the absolute size of today's real exchange rate appreciation has to be smaller than tomorrow's exchange rate depreciation.

Effects of a Savings Subsidy

Since this does not change the after-tax marginal product of capital, the immediate effect on investments is negligible. As current consumption is now more expensive than future consumption, it drops. In the short run, with Y, I, and G fixed, the decline in consumption means that the excess goods have to be sold abroad. To ensure that X will rise, the exchange rate depreciates and causes the trade balance to improve.

In the long run, yesterday's trade surplus now enables a trade deficit. To accomplish this reversal in the trade account, the exchange rate appreciates, causing exports to fall. The new steady-state trade deficit is paid for by the amortization of yesterday's loan to the foreigners.

Effects of an Investment Tax Credit

There are two ways to finance the additional investment spending. The first is to squeeze current consumption, and the second is to borrow from abroad. Given that today's investment will raise tomorrow's income, intertemporal smoothing of consumption dictates that it would not be optimal to reduce today's consumption by the same amount as the increase in investment. It is optimal to finance part of the investment with foreign savings. In the short run, with

$$|\Delta C| < |\Delta I|, \tag{10}$$

the trade account will turn negative, requiring the exchange rate to appreciate and reduce exports.

In the long run, the skeletal model would predict that the exchange rate would depreciate in order to increase exports and therefore yield a trade surplus to repay the previous loan. The long-run sign of the trade account is the one instance, out of twenty-four, in which the skeletal model did not agree with the high-tech model. The difference comes from the existence of portfolio allocation decisions in the latter. The investment tax credit stimulates U.S. residents' desire to increase their capital holding so much that they turn their trade balance positive in the medium run in order greatly to increase their holdings of foreign assets. This massive accumulation of foreign assets turns the net income flow positive in the new steady state, causing the new steady-state trade balance to be negative.

The price for the neglect of portfolio management in the skeletal model is that, under this scenario, it is unreliable beyond a medium-run analysis. But, since the skeletal model's prediction on export and consumption levels still holds, it is inadequate for guiding policy only if the overwhelming concern is with the effect of an investment tax credit on the steady-state trade surplus.

Using the Results of This Paper for Policy-making

Let me now make three observations on why this high-tech model provides no more guidance to policy-making than the skeletal model does. The first observation is on the welfare criteria chosen. The focus of the paper is the effect of savings and investment subsidies on competitiveness, and competitiveness is defined as the volume of exports. This definition captures only one aspect of the debate over competitiveness. A large part of the relevant literature, under the heading of strategic trade policy, is more concerned about the composition than about the volume of exports. Since technical advances are more likely in some industries than others, the product mix may very well determine the future trend growth rate of the economy. In other words, to be and continue to be a "world-class economy" (to use Lester Thurow's phrase) means exporting high value added goods rather than a flood of low value added trinkets.

The analysis of investment tax credit in this paper is misleading in an important way. The important question facing policy-makers is not whether we should have an investment tax credit or a savings subsidy but whether we should have a general investment tax credit or a specific investment tax credit.

As the concern about competitiveness comes from welfare considerations, the correct indicator for economic welfare is consumption, not export volume. It is therefore surprising that the paper makes no mention of the consumption changes brought about by the investment and savings subsidy.

The second shortcoming of the analysis is that it can tell us only in which direction a variable would change in the short run and in the steady state on a policy shock. The analysis cannot be used to infer the relative efficacy of savings and investment subsidy by looking at the timing and size of the response of the endogenous variables. The fact that, under the zero capital mobility setting, consumption in the fifth period has returned to positive under the savings subsidy and is still negative under the investment credit cannot be used for welfare analysis because the authors have not provided a common scale to measure the savings and investment stimulus. The time profile of the response depends on the size of the exogenous shock, and so we cannot evaluate the relative desirability of these two policies on the basis of the simulation unless we know that the two policy shocks are of the same magnitude.

I would like to note that there is usually no unique way to scale the shocks. The scaling sometimes depends on the objective of the exercise. For example, a scaling that emphasizes capital accumulation is to set the savings subsidy at an arbitrary level, measure its effect on steady-state capital stock, and then regard the amount of investment credit needed to generate this new level of capital stock as imparting the equivalent distortion. The desirability of the two policies in inducing this capital formation is then ranked by the consumption paths generated as by-products.

In this paper, the assumption of constant total taxes rules out the usual "cost to the budget" criteria. The general point is that, until the authors can provide a scaling that is relevant to the competitiveness, we cannot choose between the different policies.

My final skepticism is about the reliability of the model. Since there are more than one set of parameters that can replicate the benchmark figures, I would have a lot more faith in the model if the authors had chosen the parameter set that yielded the best replication of the trade deficits in the last five years.

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