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11 Alternative Models of the Foreign Sector

11.1 Introduction

In chapter 3 we described our basic treatment of foreign trade. The standard version of the model uses constant elasticity excess demand functions to describe the merchandise trade of the rest of the world with the United States. The standard version of the model has two variants. The first variant deals only with net trade flows. In this case, none of the nineteen commodities can be exported and imported simultaneously. However, as described in section 3.6, this treatment conflicts with the empirical observation that many products are crosshauled. We allow for crosshauling under the gross trade flows variant of the model. The gross trade flows variant seems to us to be the more realistic one. Consequently, all of the results reported until now were obtained using the constant elasticity gross flows formulation.

There are two reasons for examining more sophisticated models of trade behavior. First, we would like to be able to analyze realistically those tax policy issues that are believed to have their principal effects on the foreign sector. Second, we would like to see how sensitive the findings of our earlier chapters are to the specification of the external sector.

In this chapter we develop some alternative treatments of the international economy. The first of these is a formulation in which we treat certain imports as imperfect substitutes for comparable domestic products. We then present two formulations that model capital mobility between the United States and the rest of the world. The first of these

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formulations introduces international flows of capital services which depend on the difference between U.S. and foreign rates of return to capital. An elasticity parameter controls the sensitivity of the capital service flows to rate-of-return differentials. The second of these formulations is similar, but involves capital goods rather than capital services.

In order to evaluate the sensitivity of the model to these different specifications, we analyze the integration of corporate and personal income taxes (see chapter 8) and the introduction of a consumption tax in the United States (see chapter 9) under each of these alternative formulations. We also consider the effects of adopting alternative forms of a value-added tax (VAT) in the United States. We consider VATs of both the income and consumption type, and on both the destination and origin basis. We have delayed looking at the VAT until now, partly because much of the debate on the VAT has centered on foreign trade issues.

It does not appear that the formulation with imperfectly substitutable imports changes our results very much. The welfare gain from adoption of a consumption tax is between 10 and 20 percent lower under this new formulation. The results for corporate tax integration are virtually identical to those of our standard case. Much greater differences arise as a result of the new models of capital flows. The consumption tax is no longer a very attractive policy under either of the models with capital flows. In the capital service flow version, the consumption tax leads to very substantial losses. The intuition behind these results is that, if the world capital market functions well, a policy such as a consumption tax will not significantly increase the U.S. capital stock.

Whereas the consumption tax no longer leads to large welfare gains under the international capital flow formulations, the efficiency gains implied by corporate tax integration are increased. Integration causes the after-corporate-tax rate of return to capital to increase, thus leading to capital inflows. Under some specifications of the capital service flow model, the welfare gain from corporate tax integration is twice as great as it is with the standard model. However, considerable uncertainty exists about the value of some of the key parameters of the capital flow models. Therefore, we provide fairly detailed sensitivity analyses.

We analyze two types of value-added taxes, each at a 10 percent rate. Value-added taxes of the consumption type lead to substantial welfare gains under all four variants of the model. Income-type VATs lead to considerably smaller welfare gains in most cases. The results for the VAT models are fairly sensitive to the type of equal yield replacement tax, since a 10 percent VAT generates a great deal of revenue.

In sections 11.2 through 11.4 we present our alternative models of the foreign sector. In section 11.5 we discuss the linkage between foreign trade issues and tax policy design. The following section includes the results of simulations using various formulations of the external sector.

These include a brief review of the results from the standard version of the model, as well as sensitivity analyses with respect to the elasticity parameters that control the shape of the offer surface in our basic constant elasticity formulation.

11.2 A Model of Trade with Imperfectly Substitutable Imports

Our first alternative specification of the external sector separates imports into two broad categories, depending on whether they are perfect or imperfect substitutes in production for domestically produced intermediate goods.

In the basic version of the model we treat all imports as perfect substitutes in production for producer goods made in the United States. We then represent these imports as a negative component of final demand. Consequently, every additional unit of import of producer good i reduces the gross output requirement of industry i by one unit. Industries demanding intermediate goods from industry i are assumed to be indifferent as to whether those goods are produced at home or imported.

We now consider a model specification that allows some imports to be imperfect substitutes for domestic goods in production. Under this specification we introduce a single new aggregated import commodity, which enters the production structure as an imperfectly substitutable input. This specification invokes the Armington assumption, since it assumes that a qualitative difference exists between the imported input and any domestic inputs used in production (Armington 1969).

The foreign excess demand equations are now

$$M_i = M_i^0\left(\frac{P_{M_i}}{e}\right)^{\mu}, \qquad 0 < \mu < \infty, \quad i = 1, \ldots, n; \tag{11.1}$$

$$E_i = E_i^0\left(\frac{P_{E_i}}{e}\right)^{\nu}, \qquad -\infty < \nu < -1, \quad i = 1, \ldots, n; \tag{11.2}$$

and

$$R = R^0\left(\frac{P_R}{e}\right)^{\mu}, \qquad 0 < \mu < \infty; \tag{11.3}$$

where M_i is the supply of imports in the i^{th} industry, E_i is that industry's export demand, and e is the exchange rate. Equation (11.3) is the supply function for the import commodity. The R in equation (11.3) can be taken to stand for resources. We treat R like the other factors of production, capital and labor. The demand for R is derived from production requirements. We should also note that M_i^0 in equation (11.1) and E_i^0 in equation (11.2) may represent either gross or net trade flows in the base case where all prices and the exchange rate are unity.

The trade balance condition is now

$$P_R R + \sum_{i=1}^{n} P_{M_i} M_i = \sum_{i=1}^{n} P_{E_i} E_i. \tag{11.4}$$

Let

$$\gamma_1 = (P_R)^{\mu+1} R^0 + \sum_{i=1}^{n} (P_{M_i})^{\mu+1} M_i^0, \tag{11.5}$$

and

$$\gamma_2 = \sum_{i=1}^{n} (P_{E_i})^{\nu+1} E_i^0. \tag{11.6}$$

Then, substituting (11.1), (11.2), and (11.3) into (11.4), and using the notation of (11.5) and (11.6), we get

$$e = \left(\frac{\gamma_2}{\gamma_1}\right)^{\frac{1}{\nu-\mu}}, \tag{11.7}$$

and

$$M_i = M_i^0 P_{M_i}^{\mu} \left(\frac{\gamma_2}{\gamma_1}\right)^{\frac{\mu}{\mu-\nu}}, \tag{11.8}$$

$$E_i = E_i^0 P_{E_i}^{\nu} \left(\frac{\gamma_2}{\gamma_1}\right)^{\frac{\nu}{\mu-\nu}}, \tag{11.9}$$

$$R_i = R^0 P_R^{\mu} \left(\frac{\gamma_2}{\gamma_1}\right)^{\frac{\mu}{\mu-\nu}}. \tag{11.10}$$

As in chapter 3, these are the reduced form or trade-balance-compensated import supply and export demand equations. They provide a constant elasticity set of excess demand functions to describe trade behavior.

With this formulation we also must modify the production structure to incorporate the imported resource. In the previous version of the model, the production function for each sector could be written as

$$Q_j = \min\left[\frac{1}{a_{0j}} VA(K_j, L_j), \frac{x_{1j}}{a_{1j}}, \ldots, \frac{x_{nj}}{a_{nj}}\right], \tag{11.11}$$

where the a_{ij} $(i = 1, \ldots, n)$ are the fixed intermediate input requirements per unit of output, x_{ij} are the intermediate inputs, $VA(\cdot, \cdot)$ is the CES value-added function for sector j with capital (K_j) and labor (L_j) as inputs, and a_{0j} is the requirement of value added per unit of output.

Under this new specification, the production function is

$$(11.12) \qquad Q_j = \min\left[\frac{1}{a_{0j}} J[VA(K_j, L_j), R], \frac{x_{1j}}{a_{1j}}, \ldots, \frac{x_{nj}}{a_{nj}}\right],$$

where J is a CES or Cobb-Douglas function for each sector, and a_{0j} now represents the requirements of the resource/value-added composite per unit of output.

The solution procedure takes advantage of the separability of the production structure, as in the basic version of the model. First, we calculate the cost-minimizing proportions of capital and labor that each industry should use in its value-added function. Using this information we can then find the cost-minimizing proportions of domestic-factor value added (VA) and imported resources (R) for each industry. Except for this, there are no further fundamental differences between our procedures under this version of the model and our procedures in the basic version.

This specification presents us with an additional data requirement. In chapter 4 we described our procedures for using the U.S. input-output tables. In order to install the version of the model with imperfectly substitutable imports, we went back to the input-output tables and identified a row of imports by industry. In table 11.1 we show the quantities of

Table 11.1 **Ordinary (Perfectly Substitutable) Imports and Armington (Imperfectly Substitutable) Imports in 1973 (in millions of dollars)**

Sector	Ordinary Imports	Armington Imports	Total
Agriculture, forestry, and fisheries	3467.3	1240.0	4707.3
Mining	898.5	323.0	1221.5
Crude petroleum and gas	5009.2	181.4	5190.6
Construction	0.0	0.0	0.0
Food and tobacco	756.9	4933.5	5690.4
Textiles, apparel, and leather	3885.0	1856.5	5741.5
Paper and printing	924.6	1245.4	2170.0
Petroleum refining	1189.7	1950.1	3139.8
Chemicals and rubber	984.3	2525.2	3509.5
Lumber, furniture, stone, clay, and glass	0.0	2760.9	2760.9
Metals and machinery	18803.6	6446.7	25250.3
Transportation equipment	1084.2	0.0	1084.2
Motor vehicles	6171.2	4067.7	10238.9
Transportation, communications, and utilities	7917.8	3666.5	11584.3
Trade	0.0	0.0	0.0
Finance and insurance	0.0	0.0	0.0
Real estate	0.0	0.0	0.0
Services	0.0	2309.6	2309.6
Government enterprises	0.0	0.0	0.0
TOTAL	51092.3	33506.5	84598.8

ordinary imports and imperfectly substitutable imports that are used in the 1973 base year. The division of the imports in each industry between ordinary imports and Armington imports seems reasonable. Industries such as food and tobacco, lumber, furniture, and services contain high proportions of Armington imports. (One thinks of Danish furniture and Norwegian sardines, which are qualitatively different from their American counterparts.) On the other hand, industries with more homogeneous outputs, such as crude petroleum and gas and transportation equipment, use ordinary imports for the most part.

We also need to specify a substitution elasticity between U.S. value added and R. For this we use estimates of the aggregate price elasticity of import demand for the United States. As our central case value we use 1.7 to represent the pure substitution effect between domestic value added and imported resources. However, we do not believe that this should be treated as an extremely precise estimate. Therefore, we will perform sensitivity analyses with respect to this parameter by using the values of 0.5, 1.0, and 3.0.

11.3 A Simple Model of International Capital Flows

In our model of international capital flows we add an additional consumer to the model. This consumer is "the foreigner" who is endowed with large quantities of those commodities that the United States imports, and with a large amount of capital services. In the benchmark year the foreigner's endowment of each import commodity is usually set at five times the benchmark level of imports of that commodity by the United States, while the foreigner's capital services endowment is five times the U.S. capital services endowment in the benchmark. In order to analyze the sensitivity of the model, we have varied the magnitudes of the foreigner's endowments of import goods and capital services. We assume that the foreigner "consumes" most of his endowments; that is, most of these import goods and capital services are used by the foreign economy rather than sold or rented to the United States. In the benchmark, in particular, we assume that the foreigner sells just the observed amount of imports (one-fifth of his endowment) to the U.S. economy and rents no capital services to the United States. Thus, the foreigner consumes his entire endowment of capital services. Loosely speaking, this treatment might mean that these capital services are foreign resources that provide output to the foreigner directly.

As U.S. prices change with a tax change, however, the foreigner alters his behavior. If the U.S. rental price of capital increases above the benchmark level, the foreigner will "rent" some of his endowment to be used in U.S. production (i.e., there will be a capital inflow from the perspective of the United States). On the other hand, if the U.S. rental

price of capital were to fall below the benchmark level, the foreigner would "rent" U.S. capital for his foreign consumption (i.e., there will be a capital outflow from the U.S. perspective).

This behavior is specified as

$$W_K - X_K = W_K \cdot P_K^{E_K}, \tag{11.13}$$

where W_K is the capital service endowment of the foreigner, X_K is capital services rented to the United States by the foreigner (or rented from the United States if X_K is negative), and E_K is an elasticity parameter controlling capital flow responses in the model. P_K is the rental rate of capital in the United States. Since $P_K = 1$ in the benchmark, the benchmark value of X_K is zero.

The critical parameters in this formulation are the ratio of W_K to the U.S. capital service endowment (5 in our central case analysis) and E_K. E_K should be negative to give the capital service flow responses we require, although there does not seem to be a consensus as to what value to use. We highlight two values of E_K: -1.0 and -0.5. For sensitivity analysis we also use values of 0.0, -0.1, and -4.0 for E_K.

Equation (11.13) thus determines capital service flows in the model, once factor prices are known. A two-stage procedure is involved in determining foreign behavior. We first determine X_K from P_K. Once X_K is known, we can calculate the amount of income the foreigner has left over for expenditure on all other goods. For simplicity we specify a Cobb-Douglas function for the foreigner's expenditure on all other goods. We use benchmark data to determine the weights for this Cobb-Douglas function.

It might be interesting to evaluate the welfare of the foreigner, but we do not do so. As before, our welfare calculations only deal with the U.S. population, corrected for population growth. Even though this version of the model is more complicated than earlier versions, it is still basically true that our treatment of the foreign sector merely closes the model. In this connection it is worthwhile to note that we do *not* derive equation (11.13) from any explicit model of the utility-maximizing behavior of the foreigner. The literature now contains several completely specified multicountry general equilibrium models. In these models the behavior of consumers, producers, and governments in each of several countries is specified explicitly and symmetrically. (For a survey of these models, see Shoven and Whalley 1984).

Our work in this area is motivated in part by the recent debate about the world capital market between Arnold Harberger on one side and Martin Feldstein and Charles Horioka on the other. This debate is important because of its implications for policy evaluation using general equilibrium tax models. In a world with a perfect, frictionless international capital market, the domestic choice between an income and con-

sumption tax would have little effect on the aggregate domestic employment of capital. Despite the fact that an income tax discourages saving by U.S. consumers, and thus tends to discourage capital formation, the rest of the world would provide U.S. industry with capital until its rate of return were equal to the world level. However, an origin-based tax such as the U.S. corporation income tax would still be distortionary, affecting both the amount of capital in the economy and its allocation across industrial sectors. In his 1978 and 1980 papers, Harberger finds that there "seems to be no strong and systematic tendency for rates of return to be high in countries with a low capital stock per worker." He takes this as evidence for the existence of a reasonably well-functioning world capital market. Feldstein and Horioka (1980) observe a high correlation between the saving of countries and their levels of investment. This leads them to argue that there are severe restrictions on the operation of the world capital market. Harberger (1978) challenges these results by showing that this correlation is much lower for less-developed countries than for the OECD countries studied by Feldstein and Horioka. However, Harberger does back away from the position that the world capital market functions with perfect freedom and great speed. In a passage quoted by Feldstein (1982), Harberger says:

> My own intuition does not want to accept the notion that increments of investment activity are in all or nearly all countries effectively 100 percent "financed" by funds flowing in from abroad, and that increments in saving simply spill out into the world capital markets. I find the analogy to a hydraulic system with perhaps a viscous fluid, in which the pipes are partially clogged, and in which some vessels are separated by semipermeable membranes, to be more consonant with my image of the world than the alternative analogy to a hydraulic system where the water flows freely through the system and, essentially instantaneously, finds the same level everywhere. (1980, p. 336)

Thus, in their most recent exchange, Feldstein and Harberger seemed to be converging to the view that, while there is some pressure towards equalizing the rates of return to capital across world markets, this equilibration is incomplete, and even the partial movements observed do not occur instantaneously. The main focus of the debate seems now to be on their differing views about the speed of the adjustment. Feldstein argues that, "the tendency toward equalization must be measured in decades rather than months or even years" (1982, p. 4). Harberger seems to argue that the long run is shorter than this.

We can capture the key aspects of this debate by altering E_K, the elasticity parameter for the demand for capital services by foreigners. We find, unfortunately, that our model results are fairly sensitive to the value of this parameter. Finally, let us note that we always use the basic constant elasticity formulation of foreign trade along with the new models of capital markets described here and in the next section.

11.4 A Model with Capital Purchases

In the model of section 11.3 the foreigner is endowed with a large amount of capital service which he "rents" to the United States if the U.S. offers a higher rental price. If the rental price in the United States falls, the foreigner rents capital from the United States. While this is a step toward including world capital markets in our model, it fails to capture important aspects of foreign investment.

Under this specification a capital inflow involves a financial outflow (the United States must make the rental payments). However, it may be that the more likely response to high rates of return in the United States would be direct foreign investment in the U.S. In this case the foreigner would *purchase* U.S. capital goods, rather than rent them, providing the United States with an immediate financial inflow. Rather than receive immediate financial compensation, the foreigner accumulates a claim on the future earnings of the capital acquired by these purchases.

This behavior can be incorporated in our model by using a somewhat different representation of the foreigner. The initial U.S. capital endowment of the foreigner is taken to be zero. The foreigner, however, can acquire United States capital by purchasing the saving good (the sixteenth consumer good, which is a fixed proportion portfolio of real investment goods). He will do this if the expected rate of return on U.S. investments rises above the benchmark level. The foreigner is interested in the rate-of-return net of the corporation income tax, the corporation franchise tax, and property taxes. If the U.S. rate of return should fall, the foreigner may sell foreign capital to domestic savers. Once again, we do not model the production structure of the rest of the world. Instead, the foreigner simply "consumes" foreign capital, as in section 11.3.

This formulation is reasonably complex in terms of modeling. There are now two kinds of capital goods—foreign and domestic. The two types of capital offer separate (although conceivably identical) rates of return. Initially, domestic consumers own only domestic capital and the foreigner owns only foreign capital. The demand functions are structured such that the foreigners will save in the United States only if the U.S. rate of return rises above the foreign rate, whereas the U.S. consumers will purchase foreign capital service endowments only if the U.S. rate of return falls below the foreign rate. While the U.S. rate of return is endogenous in the model, the foreign rate is usually set at the benchmark rate, although it can be influenced by certain tax policies of the United States.[1]

1. For example, in this model the foreign rate of return is affected by a U.S. policy that changes the percentage of U.S. consumers' saving that can be deducted from taxable income. Such a policy alters the after-tax price of saving to U.S. consumers, whether the saving is made at home or abroad. Consequently, the policy affects the foreign rate of return to U.S. consumers of saving abroad.

Saving behavior in the United States stems from the same demand functions as in our standard model, except that it involves not just a domestic saving good but a composite saving good aggregated over domestic and foreign saving goods. For each household,

$$S = \theta S^D + (1 - \theta) S^F, \tag{11.14}$$

where S is total saving, and S^D and S^F are domestic and foreign saving goods acquired. θ is a distribution parameter that depends on the relation between domestic and foreign rates of return (r^F and r^{US}) according to:

$$\begin{aligned} \theta &= 1, && \text{if } r^{US} \geq r^F; \\ \theta &= e^{-Z_1(r^F - r^{US})}, && \text{if } r^{US} < r^F. \end{aligned} \tag{11.15}$$

Here, r^F and r^{US} are rates of return to U.S. consumers. Because of differences in marginal tax rates, r^F and r^{US} each will differ across the twelve consumer groups. We account for these differences in the model, although for convenience we speak of a single r^F and r^{US} in this discussion.

In the benchmark, $r^F = r^{US}$ and $\theta = 1$ (U.S. households buy no foreign capital goods). In the solution of the model, θ for each household is used to form a composite price for saving goods, which enters household budget constraints. Household utility functions only have an interpretation over composite goods, since we do not investigate the real characteristics of assets (such as risk) that would account for a diversified portfolio by savers. Once again, the literature only provides us with a very rough guide as to what a reasonable value of Z_1 might be. After considerable experimentation with different values for this parameter, we have decided to highlight the results from simulations with $Z_1 = 250$ and $Z_1 = 50$. We also provide further sensitivity analyses for values of Z_1 outside of this range.

The foreigner's saving in the United States, S^F_{US}, is given by

$$\begin{aligned} S^F_{US} &= 0, && \text{if } r^{US}_F \leq r^F_F; \\ S^F_{US} &= Z_2(r^{US}_F - r^F_F)^{Z_3}, && \text{if } r^{US}_F > r^F_F. \end{aligned} \tag{11.16}$$

Here, r^{US}_F and r^F_F are U.S. and foreign rates of return expected by the foreigner. Because U.S. consumers are not treated identically in the tax system, r^{US} generally differs from r^{US}_F, and r^F from r^F_F.

A two-stage procedure similar to that in section 11.3 applies here. First, we determine the foreigner's investment behavior. Then, the foreigner's expenditures on other goods are allocated according to a Cobb-Douglas utility function. In this case our dynamic sequencing of equilibria takes account of previous investment abroad in determining the capital service endowments in each country in each period. In our central case analysis we set Z_2 equal to 50,000 and Z_3 equal to 0.5. We perform

sensitivity analyses on the values of Z_2 and Z_3 when we simulate corporate tax integration. The parameters Z_2 and Z_3 are irrelevant to the study of the consumption tax, since the domestic price of capital drops in that case and the foreigner does not save in the United States. Similarly, Z_1 is irrelevant to the case of corporate tax integration, because the domestic rate of return increases in that case and domestic consumers do all of their saving at home.

11.5 Taxes and Foreign Trade

In this section we explore some of the issues linking international trade to the design of taxes and explore how they can be analyzed using the different external sector formulations in the U.S. general equilibrium model. First, we explore the foreign trade linkage to the value-added tax. Next, we consider the difference between broadly based taxes that use the *origin basis* and those that use the *destination basis*. Finally, we discuss some issues connected with factor mobility and tax structure.

11.5.1 The Value-Added Tax and Foreign Trade

Value-added taxes (VATs) have been used in Europe for almost three decades, but have never been used in the United States. Nevertheless, there is a great deal of interest in adopting a VAT in the United States. Much of this interest was sparked by bills introduced by Representative Al Ullman (D-Ore.), the former chairman of the House Ways and Means Committee.

The development of the tax in Europe follows from the difficulties in France, Germany, and other countries with the turnover taxes that existed before the war and in the period immediately following. Under a tunover tax each firm pays a tax on the total value of sales, with no credit given for the taxes already paid on intermediate inputs. Turnover taxes lead to "cascading," with the taxes compounding when the production process involves several stages or market exchanges. The turnover tax provided an incentive for firms to integrate vertically in order to avoid taxes. The turnover taxes were administered on a destination basis, thus it became very difficult to agree on the appropriate way to rebate taxes on export items. European nations were forced to negotiate annually in order to agree on mean tax rates by product. These negotiations were a rough attempt to take account of international differences in the degree of vertical integration.

In the early 1950s the French began to seek ways to avoid these problems of the turnover tax. They were attracted to the value-added tax for administrative reasons.[2] A value-added tax can be administered in a

2. *Value added* is simply the summation of returns to labor and capital by industry. We can calculate it as the total value of sales by industry minus all material inputs.

number of different ways. The tax can be applied directly to value added (as a composite payroll and capital income tax) or indirectly as a tax on the total value of sales less the cost of material inputs. Most European countries now administer the tax by the so-called credit method, under which a company is taxable on the total value of sales but receives a credit for all taxes paid on intermediate inputs purchased in earlier stages of the production process. During the initial debate on the VAT in France, it was pointed out that, under a retail sales tax or a turnover tax, tax administrators typically collect the largest fraction of the tax from a large number of relatively small retail outlets. This contrasts with the value-added tax. Since the VAT is collected as the value of the product accumulates through the production process, a significant portion of the tax would be collected from a relatively small number of large primary producers. Thus, the VAT was represented as being administratively more cost efficient than other taxes, since tax administrators found it easier to collect a large amount of tax from a small number of producers.

This type of argument was extended as the European Economic Community (EEC) moved into the field of tax design. In the initial stage of economic harmonization, the nations of the EEC eliminated all tariffs between member countries and adopted a common external tariff. It was then argued that further progress toward economic union would require the member nations to harmonize their tax systems. By the middle 1960s the nations of the EEC became convinced that they should adopt a common system of indirect taxation. The system eventually adopted involved a value-added tax for each member nation.

As administered in the EEC, the VAT is a tax of the consumption type, under which the tax incorporates complete deductibility of products purchased for business use, including capital goods. In its broadly based variant, where all value added is taxed at the same rate, this tax is to be thought of as equivalent to a retail sales tax on consumption.

An alternative form of a value-added tax is what Carl Shoup (1969) calls a VAT of the income type. Under this arrangement the firm can only take deductions for depreciation. The base of this tax is equivalent to that of a flat personal income tax without any exemptions. However, the tax is collected from firms rather than from individuals. Finally, Shoup suggests a VAT of the product type, where there is no deduction for depreciation. The base of this type of VAT is the same as GNP.

11.5.2 The Origin and Destination Basis Issue and International Trade

Another feature of the VAT in Europe is that it is levied on a *destination basis*, under which exports leave the country tax free, while imports are taxed when they enter. This contrasts with the *origin basis*, under which the tax is applied at the site of manufacture. The choice between the origin basis and the destination basis for indirect taxes has attracted a

good deal of attention over the last fifteen to twenty years. This issue is a clear example of the link between tax design and foreign trade concerns. Most of the major trading partners of the United States have broadly based indirect taxes that operate on the destination basis. We have already mentioned the VAT in the European Economic Community. In addition, Japan has a commodity tax and Canada has a federally operated manufacturers' sales tax.

A common argument repeated over the years is that the United States is placed at a disadvantage by this tax treatment, since the taxes on American firms are not rebated on export items, whereas import items enter the United States tax free. Such a disadvantage might exist in the very short run. However, we believe that this argument does not stand up to close scrutiny in the context of long-run equilibrium.

One of the prominent themes within the academic literature is that with broadly based taxes, the destination basis and the origin basis do not differ in their effects in long-run equilibrium (provided that no discrimination arises in the tax rates) (see Johnson and Krauss 1970). With flexible exchange rates, a movement between the two bases can be offset by an exchange rate change that leaves the real characteristics (trade flows) unchanged. With fixed exchange rates, changes in domestic price levels (and implied changes in domestic money stocks) preserve the real equilibrium. Thus, in long-run equilibrium, a movement from one tax basis to another is equivalent to a purely monetary phenomenon with no implications for real economic behavior.

This can be shown as follows.[3] As a simplification we consider two countries, each producing a single good, X_1 in 1, X_2 in 2. P_1 and P_2 represent the cost-covering competitive producer prices of products in each country, in domestic currencies. Let e be the exchange rate between currency 1 and 2. Demands for products in each country depend on relative prices in domestic currencies: X_1^2 are exports by 1 to 2; X_2^1 are exports by 2 to 1. For each country, balance in international payments requires that the domestic currency value of outflows equal the domestic currency value of inflows. We consider a single consumer in each country and assume that all tax revenues are redistributed in lump-sum form. We can consider three regimes: (1) no tax, (2) a destination-based tax in country 1, and (3) an origin-based tax in country 1. If we examine the balance-of-payments conditions (from the viewpoint of either country) and relative commodity prices (in domestic currencies) under each of these regimes, we will see that the relative commodity prices that determine consumer behavior remain unchanged and the same real trade flows will satisfy the balance-of-payments conditions in all three cases. The truth of this proposition is independent of the exchange rate regime. The

3. The analytics that follow draw upon the arguments presented in Whalley 1979.

Table 11.2 **Balance-of-Payments Conditions and Relative Prices under Various Tax Regimes**

Tax Regime	Balance-of-Payments Condition for Country 1	Relative Prices Denominated in Domestic Currenty 1
1. No tax	$P_1^{NT}X_1^2 = e^{NT}P^{NT}X_2^1$	$P_1^{NT}/e^{NT}P_2^{NT}$
2. Destination tax (rate t_1)	$P_1^DX_1^2 = e^DP_2^DX_2^1$	$P_1^D(1+t_1)/e^DP_2^D(1+t_1)$
3. Origin tax (rate t_1)	$P_1^O(1+t_1)X_1^2 = e^OP_2^OX_2^1$	$P_1^O(1+t_1)/e^OP_2^O$

information upon which these conclusions are based is summarized in table 11.2. The superscripts NT, D, and O refer to the no-tax, destination-tax, and origin-tax regimes. Relative prices are unchanged in all regimes, and the same X_1^2, X_2^1 satisfy the balance-of-payments conditions under all regimes if,

$$(11.17)\quad \text{with flexible exchange rates: } e^D = e^{NT},\ P_1^D = P_1^{NT},\ P_2^D = P_2^{NT},\quad e^O = (1+t_1)e^{NT},\ P_1^O = P_1^{NT},\ P_2^O = P_2^{NT};$$

$$(11.18)\quad \text{or with fixed exchange rates: } e^D = e^{NT},\ P_1^D = P_1^{NT},\ P_2^D = P_2^{NT},\quad e^O = e^{NT},\ P_1^O = P_1^{NT}/(1+t_1),\ P_2^O = P_2^{NT}.$$

Thus, the introduction of a broadly based tax or a change in basis is equivalent to a purely monetary change. It does not affect real trade flows and thus does not restrict trade.

A similar argument is sometimes made regarding international tax unions. The argument is that it is necessary for the members of such a union (such as the members of the EEC) to have similar tax rates in order for the tax distortions between them to be removed. However, a careful analysis will show once again that the no-tax equilibrium will be preserved, even when two countries have different tax rates. This is true regardless of whether the origin base or the destination base is used. The same conclusion also holds if one country uses the origin basis and the other uses the destination basis.

We model origin-based taxes as factor taxes and destination-based taxes as sales taxes, because this is the easiest way to capture the difference between an origin-based and a destination-based tax. A factor tax is origin based because it applies to exports but not to imports. A sales tax is destination based because it applies to imports but not to exports. For broadly based taxes the neutrality of movements between the two tax bases applies, since we use a classical general equilibrium approach.

11.5.3 Taxes and International Capital Mobility

Another area of concern is the tax treatment of foreign investment inflows and outflows. The tax laws governing foreign investment are very

complex. Typically, profits will originate in one country (the "host" country), and a portion of these profits will be paid through a parent company in another country (the "destination" country) to the stockholders. The profits originating in the host country are usually subject to four separate layers of tax. First, the host country levies a corporate tax. Next, the host country levies a withholding tax on dividends and interest paid. This tax is designed to substitute for personal income tax in the host country. The next tax is the corporate tax in the destination country, followed by the personal income tax in the destination country.

These four layers of tax can be a very heavy burden. As a result, most nations grant some sort of tax relief to the income from foreign investment. Such tax relief can be granted unilaterally or can result from negotiated tax treaties. The United States unilaterally allows corporations a credit for taxes paid abroad. The United States also has a number of treaties that deal symmetrically with profits flowing into or out of the United States. Under these treaties the withholding tax rate on profits paid in either direction is the same.

Now that we have described the existing arrangements for the tax treatment of foreign investments, let us discuss the economic incentives that influence such arrangements. Some of these incentives are described by Koichi Hamada (1966). Figure 11.1 is based on the diagram in Hamada's paper. In this static, two-country model, capital in country 1 is measured from left to right, and capital in country 2 is measured from right to left. Country 1 has a fixed capital endowment of $\bar{K}_1$, and country 2 has a fixed endowment of $\bar{K}_2$. In each country the marginal value product of capital schedule is downward sloping. These schedules are shown as MVP_{K_1} and MVP_{K_2}. The capital endowments will be used most efficiently if the value of the marginal product is equal in both countries. In general,

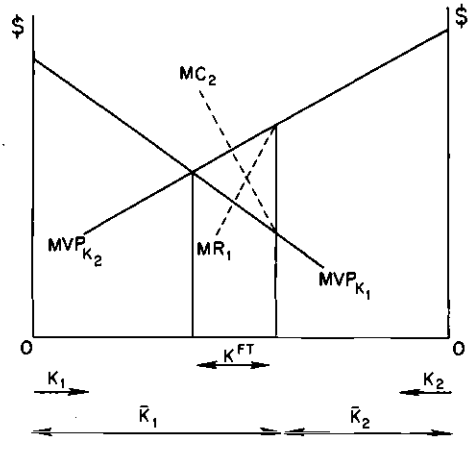

Fig. 11.1 International capital flows in the Hamada model.

this condition will not be met unless there is an international flow of capital. In figure 11.1, this flow is of K^{FT} from country 1 to country 2, in the free-trade situation where there are no taxes or other impediments to the movement of capital.

Hamada's point is that each country has an incentive to use tax policy to interfere with this capital flow. First, let us look at the situation from the point of view of country 1—the capital-exporting country. The marginal cost to country 1 of exporting capital abroad is the foregone marginal value product of capital in 1, given by the MVP_{K_1} curve. However, the marginal revenue obtained by exporting capital is not equal to the marginal value product of capital schedule in country 2. This marginal value schedule determines the average return received by capital sent abroad. Therefore, as more units of capital are exported by 1 to 2, the price received on *all* units sent abroad is bid down. The marginal value product schedule of country 2 is the average revenue schedule to country 1; thus from the point of view of country 1 the marginal revenue schedule MR_1 is more steeply sloped than the marginal value product of capital schedule in country 2.

Thus, if country 1 can restrict the capital flow and, through a tax, extract the differential between the marginal value product in country 1 and country 2, country 1 would be better off than in the free-trade situation. It would then receive a larger share of a smaller total output but would still be better off.

Figure 11.2 conveys much the same information as figure 11.1, except that it uses a separate diagram for each nation. The rate of return at which the marginal products are equalized in the no-tax case is r_0. The total welfare of country 1 is $ABCD + EFG\bar{K}_2$, where $C\bar{K}_1 = \bar{K}_2G$ is the flow of capital. If country 1 then imposes a tax on income received from abroad, the capital flow will be reduced to, say, $H\bar{K}_1 = \bar{K}_2M$. The net-of-tax rate of return in the two countries will be equalized at r_{net}. However, the gross return to capital in country 2 will be greater by the amount of tax. After

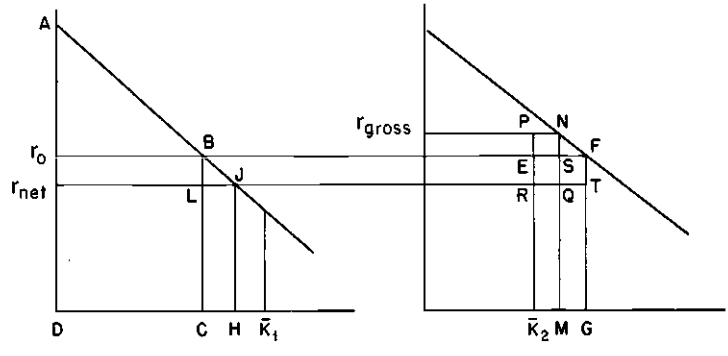

Fig. 11.2 The international allocation of capital.

the imposition of the tax, country 1's total welfare will be $AJHD + PNMK_2$. Tax revenue is $PNQR$. Country 1 has given up $SFGM$, but it gains $PNSE + BJHC$. We know that $CH = MG$, because country 1's capital exports must equal country 2's capital imports, both before and after the policy change. Therefore, $LJHC = QTGM$, so country 1's gains outweigh its losses.

If we return to figure 11.1, we can see that similar arguments apply to country 2—the capital-importing country. For the capital-importing country, the marginal value product schedule in country 2 is the relevant marginal revenue schedule. However, the marginal value product of capital schedule in country 1 represents the average cost schedule to country 1, since the price paid for capital is determined by the market price for the last unit of internationally mobile capital. Thus, country 2 faces a marginal cost schedule (MC_2 in figure 11.1), and country 2 also has an incentive to interfere in the capital flow through tax policy. From the point of view of country 2, this tax policy would attempt to extract the differential between the two marginal value product schedules. If country 2 were able to impose a tax with no retaliation from country 1, then the citizens of country 2 would make themselves better off than they were in the free-trade situation.

The typical outcome in this situation is that each country would retaliate to the other's tax, and a postretaliation equilibrium situation would result. Double taxation treaties are appealing because the participants in such treaties act to return the world economy closer to the free-trade situation. It is not always the case, however, that countries are worse off in a postretaliation equilibrium than they would be in the presence of free trade. In the case that Hamada considers, where the marginal schedules are linear, it is always true that both countries are worse off. However, with nonlinear schedules, it may be possible for a country to be better off in the postretaliation equilibrium. Consequently, certain countries may not consider it advantageous to negotiate double taxation treaties with the United States.

Hamada's piece sheds light on the circumstances under which one can make a case for double taxation treaties on capital income received from abroad. In our model we are unable to analyze the issue of retaliation. However, our capital good flow and capital service flow models do capture the incentive for one country to intervene, while abstracting from the issue of retaliation.

11.6 Policy Analyses under Alternative Formulations of the External Sector

In this section we simulate the effects of several policy proposals, using the various formulations of the external sector presented in sections 11.2,

11.3, and 11.4. We consider corporate tax integration (see chapter 8), the consumption tax (see chapter 9), and various forms of the value-added tax.

These analyses involve the same numerical specification we have used throughout. We use the same values for all parameters that do not deal with the external sector. The various external sector formulations are incorporated as separate model extensions.

For the sake of brevity, we refer to the four formulations as follows:

1. *Constant Elasticity, No Armington.* Foreigner's behavior involves constant elasticity excess demand functions; no Armington heterogeneity enters; no capital service or capital good flows are considered.
2. *Constant Elasticity with Armington.* As in (1), except that we also consider Armington product heterogeneity for imported intermediate inputs, as described in section 11.2.
3. *Capital Services Flows.* Flows of capital services take place between the United States and the rest of the world as described in section 11.3.
4. *Capital Goods Flows.* Flows of capital goods take place between the United States and the rest of the world as described in section 11.4.

These formulations are listed in table 11.3, along with the values we have specified for the more critical parameters. In the case of the first formulation, we use values for μ of 0.465 and ν of -10. These were discussed in section 6.4. They jointly imply an export price elasticity of demand of -1.4. For sensitivity analyses in this case, we consider μ and ν set first at 10 and -10 and then at 1 and -1. For the $(10, -10)$ case, the export price elasticity is -5.5. In the two-good case, as ν and μ both become large (in absolute value), the elasticity of the offer curve approaches unity; this specification for the foreigner's behavior would imply that the United States is a small, open, price-taking economy. For the case of $(1, -1)$, the export price elasticity is -1, and in the two-good case the elasticity of the offer curve is ∞. We also consider cases where net trade flows rather than gross flows enter the benchmark calculation.

For the second formulation, the critical parameters are μ, ν, and σ_{VA}^{R}. We take the same μ and ν values as for the central case in our first formulation. σ_{VA}^{R} is set at 1.7. In our sensitivity runs, σ_{VA}^{R} is set at 0.5, 1.0, and 3.0.

For the capital service flow and capital good flow formulations, the critical parameters are E_K, Z_1, Z_2, and Z_3, which control substitution in the two cases. The ratio of the endowment of the foreigner to that of the United States is also an important parameter. Because of our lack of knowledge about the responsiveness of international capital flows to differentials in the rate of return, we provide two sets of central case simulations for each of our formulations with international capital mobility. In the formulation with capital service flows, we set E_K at -0.5 and -1.0 (and we also provide some extra sensitivity analyses, with E_K at 0.0,

Table 11.3 **Characteristics of Alternative External Sector Specifications**

	Constant Elasticity, No Armington	Constant Elasticity with Armington	Capital Service Flows	Capital Good Flows
Described in section	3.6	11.2	11.3	11.4
Brief description	Constant elasticity excess demands; no product heterogeneity; no capital flows; gross trade flows	Constant elasticity excess demands; product heterogeneity for intermediate imports; no capital flows; gross trade flows	Capital service flows, no product heterogeneity; Cogg-Douglas commodity demands; gross trade flows	Capital good flows, no product heterogeneity; Cobb-Douglas commodity demands; gross trade flows
Critical parameters	μ, ν	μ, ν, σ^R_{VA}	E_K	Z_1, Z_2 Z_3
Values in central case	$\mu = .465$ $\nu = -10$ (jointly imply U.S. faces export price elasticity of -1.4)	$\mu = .465$ $\nu = -10$ $\sigma^R_{VA} = 1.7$	$E_K = -1.0$ or -0.5 Capital service endowment of foreigner = 5 × U.S. endowment	$Z_1 = 250$ or $Z_1 = 50$ $Z_2 = 50{,}000$ $Z_3 = 0.5$ Capital service endowment of foreigner = 5 × U.S. endowment
Sensitivity cases	$\mu = 10$ $\nu = -10$ $\mu = 1$ $\nu = -1$ gross and net trade flows	$\sigma^R_{VA} = 3.0$ $\sigma^R_{VA} = 1.0$ $\sigma^R_{VA} = 0.5$	Factor of 5 reset at 2, 10 $E_K = 0.0, -0.1, -4.0$ gross-of-tax return to capital rather than net used	Factor of 5 reset at 2, 10 $Z_1 = 1000, 100, 10$ $Z_2 = 100{,}000$ $Z_3^2 = 0.25, 1.0$

-0.1, and -4.0). Our central case ratio is 5, and in our sensitivity analyses we set the ratio at 2 and 10.

A final and important sensitivity analysis in this case involves the return to capital. In the central case, when foreigners rent to the United States, they receive P_K, the real net-of-tax rental price of capital. P_K is paid to the United States when Americans rent to foreigners. Because of the tax system in the United States, a differential exists between the marginal product of capital (the gross-of-tax price) and the net-of-tax return to capital. Thus, the United States gains if it rents capital services from abroad, since it collects the marginal product of capital but pays the net-of-tax return to capital. Conversely, if the United States rents capital to the foreigner, the United States suffers a loss. To correct for this, we calculate a tax rate that applies to international capital transactions, and we use this new rate in one of our sensitivity cases.

For the capital good flow formulation, we provide sensitivity analyses around two central case values of Z_1, namely, 250 and 50. Our central case values for Z_2 and Z_3 are 50,000 and 0.5, respectively. For sensitivity cases we use Z_1 of 1000, 100, and 10, Z_2 of 100,000 and Z_3 of 0.25 and 1.0. We also vary the foreigner's capital service endowment, so that it equals 2 times and 10 times the endowment of the United States.

11.6.1 Consumption Tax

In table 11.4 we show model results for a single tax-policy—an 80 percent savings deduction—under the different external sector formulations. This policy, described in detail in chapter 9, represents a move from the current income tax system toward a consumption tax system. We adjust marginal income tax rates either additively or multiplicatively so that the total revenue raised by the government is not altered in any period by the policy change. All results reported in this chapter come from sequences of eleven equilibria spaced five years apart.

In our central case, with no Armington good and no capital flows, the gains from the consumption tax are over $500 billion in present value, or a little over 1 percent of the total discounted welfare stream. The type of replacement tax for equal yield does not greatly affect the results. The Armington formulation does not change things much. The welfare gains are less by about 15 percent under either additive or multiplicative scaling. One reason for the similarity among the welfare gain results is shown in table 11.5. The Armington good does very little to affect the process of capital accumulation, so that the decrease in the relative price of capital is nearly identical in the Armington and non-Armington formulations. The results of simulations using these two formulations are similar in many other ways as well. In each case the decrease in the price of capital leads to a shift toward the more capital-intensive industries. By the final period in a consumption tax simulation under the standard,

Table 11.4 Further Analysis of Adoption of a Consumption Tax

	Welfare Effect	
	Additive Replacement	Multiplicative Replacement
1. Central case—constant elasticity, no Armington	556.1 (1.115)	536.9 (1.077)
2. Central case—constant elasticity with Armington	480.7 (0.964)	457.7 (0.918)
3. Central cases—capital service flow		
A. $E_K = -1.0$	−494.0 (−0.991)	−606.6 (−1.217)
B. $E_K = -0.5$	−288.7 (−0.579)	−380.5 (−0.763)
4. Central cases—capital good flow		
A. $Z_1 = 250$	−36.3 (−0.073)	−52.1 (−0.104)
B. $Z_1 = 50$	233.9 (0.469)	222.5 (0.446)

Note: Dynamic welfare effects in present value of compensating variations over time; all figures in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence ($49 trillion).

no-Armington version, the prices of the various industrial outputs range from 0.889 for the capital-intensive real estate sector to 0.977 for the labor-intensive transportation equipment sector. With the Armington formulation, the comparable prices are 0.890 and 0.977, respectively. A notable exception under either formulation is the construction industry. This is one of the more labor-intensive sectors, but its output increases by more than 11 percent under either formulation, because it is an important component of investment. The consumption tax causes an increase in investment demand that is nearly the same under either version. In the first period, the increase is about 32.8 percent over the base case. By the eleventh and final period, investment is still 27.9 percent greater than in the base case.

Much greater changes are evident when we compare our standard formulation with either of the models with capital flows. However, we should emphasize that these results are fairly sensitive to the specification of the parameters controlling the capital flows. To highlight this, we present two sets of results in tables 11.4 and 11.5, and we will present further sensitivity analyses in the next subsection. In either the capital service flow or capital good flow formulations, domestic welfare declines as the capital flows become more elastic (i.e., as we specify E_K or Z_1 to be greater in absolute value). In no case are the results very sensitive to the type of replacement tax for equal revenue yield, because the consump-

Table 11.5 **Changes in the Relative Price of Capital Services as a Result of Adoption of a Consumption Tax (additive replacement for equal yield)**

			Model Variant			
			Capital service flow		Capital good flow	
Period	Constant elasticity, no Armington	Constant elasticity with Armington	$E_K = -1.0$	$E_K = -0.5$	$Z_1 = 250$	$Z_1 = 50$
1	.988	.988	.998	997	.992	.989
2	.952	.952	.991	.985	.974	.958
3	.923	.924	.985	.974	.974	.941
4	.902	.902	.979	.966	.973	.931
5	.884	.885	.974	.958	.973	.924
6	.870	.871	.970	.951	.973	.920
7	.859	.860	.967	.946	.973	.917
8	.850	.851	.963	.941	.972	.915
9	.842	.843	.960	.936	.972	.913
10	.836	.837	.958	.932	.972	.912
11	.831	.832	.956	.929	.972	.911

tion tax does not cause as great a revenue loss as, say, corporate tax integration.

For the values of E_K that we highlight here (-1.0 and -0.5), the consumption tax causes the United States to incur substantial service outflows. As a result of this foreign demand for U.S. capital services, the relative price of capital drops much less under this variant of the model than it did in the standard version. Nevertheless, the price of capital does drop somewhat, and as it drops the rate of capital outflow increases. In the first period of a simulation with $E_K = -1.0$, using additive replacement, the capital service outflow is under $1 billion. By the eleventh period, the outflow has swollen to over $50 billion, which is nearly 9 percent of that year's saving. This capital service outflow causes a substantial welfare loss for these values of E_K. (In the next subsection we will see that a gain can still occur if E_K is close enough to zero.) The main reason for this loss is that the United States incurs substantial capital service outflows as a result of the policy change, so that the United States foregoes the gross-of-tax return to capital (capital's marginal product), but only receives the net-of-tax return.

An interesting policy prescription from this case is that the United States might gain by having additional taxes on capital income received from abroad by revoking the foreign tax credit. If the first of these policies were adopted, the additional tax rates should equal U.S. capital tax rates. We should note, however, that foreign nations may well retaliate against

such a policy change on the part of the United States. The possibility of retaliation reduces the attractiveness of increasing the taxation of capital income received from abroad. We have made no attempt to model the complex issue of retaliation. Of course, it is also true that the capital service flows about which we are concerned are driven by the move toward a consumption tax. The case for a compensatory tax on capital income received from abroad is weak if the U.S. does not undertake a policy of increased stimulus to saving.

Under the first three versions, the domestic capital stock increases very substantially. By the final period of the consumption tax simulations, the domestic capital endowment exceeds the base-case endowment by 22.9 percent in the standard model and the Armington model, and 24.7 percent in the capital service flow model (when $E_K = -1.0$). The domestic economy gains in the first two cases because all of that capital is used at home. In the capital service flow version, a great deal of it is used abroad. The results are somewhat different for the capital good flow version of the model. In this case, the domestic capital stock barely grows at all. By the final period of the sequence, the domestic capital endowment is only 2.7 percent greater than in the base case. The reason for this is that domestic consumers hold a great deal of foreign capital. In the case of $Z_1 = 250$, domestic consumers devote 8 percent of their saving in the first period to saving abroad. By the eleventh period, these purchases of foreign capital have grown to nearly 25 percent of saving, and the rental payments on the accumulated foreign capital amount to 2.6 percent of national income.

These capital flows are very substantial and may strike some readers as being rather high. This is why we have also chosen to highlight the results from simulations with $Z_1 = 50$. In this case, in the first period, domestic consumers only use a bit more than 2 percent of their saving to purchase foreign capital. By the eleventh period, they still only spend about 16 percent of their saving for foreign capital, despite the fact that the differential between foreign and domestic rates of return is much greater than it was in the simulation with $Z_1 = 250$. If the lower value of Z_1 is considered to be more realistic, then the consumption tax is a gaining proposition under the capital good flow formulation.

11.6.2 Sensitivity Analysis for Consumption Tax Results

In table 11.6 we report our sensitivity analyses for our two constant elasticity formulations. Given that the central case versions are rather similar, it may not be surprising that similar results emerge from the sensitivity cases. Neither the choice of the $\mu - \nu$ combination, nor the specification of gross or net trade flows makes very much difference to the no-Armington case. In the model with Armington goods, the elasticity of substitution between value added and the Armington good does not

Table 11.6 **Sensitivity Analysis of Consumption Tax for Constant Elasticity Formulations**

	Welfare Effect	
	Additive Replacement	Multiplicative Replacement
1. Central case—constant elasticity, no Armington, with $\mu = .465$, $\nu = -10$	556.1 (1.115)	536.9 (1.077)
2. Constant elasticity, no Armington, with $\mu = 10$, $\nu = -10$	541.8 (1.087)	527.6 (1.058)
3. Constant elasticity, no Armington, with $\mu = 1$, $\nu = -1$	585.2 (1.174)	567.9 (1.139)
4. Constant elasticity, no Armington, with net rather than gross trade flow analysis, $\mu = .465$, $\nu = -10$	575.5 (1.154)	557.7 (1.118)
5. Central case—constant elasticity with Armington, $\mu = .465$, $\nu = -10$, $\sigma^R_{VA} = 1.7$	480.7 (0.964)	457.7 (0.918)
6. Constant elasticity, with Armington, with $\mu = .465$, $\nu = -10$, $\sigma^R_{VA} = 0.5$	446.9 (0.896)	423.1 (0.848)
7. Constant elasticity, with Armington, with $\mu = .465$, $\nu = -10$, $\sigma^R_{VA} = 1.0$	468.3 (0.939)	445.1 (0.893)
8. Constant elasticity, with Armington, with $\mu = .465$, $\nu = -10$, $\sigma^R_{VA} = 3.0$	488.7 (0.980)	466.2 (0.935)

Note: Dynamic welfare effects in present value of compensating variations over time; all figures in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence ($49 trillion).

make much difference. One reason for this is that the imported resource does not represent a very large proportion of total factor inputs.[4]

In tables 11.7 and 11.8, we report our sensitivity analysis of the consumption tax results for our capital service and capital goods flow formulations. For the capital service flow formulation, we change E_K from -1.0 to 0.0, -0.1, and -4.0. We also vary the endowment ratios between 2 and 10. Clearly, our results are very sensitive to the value of E_K and somewhat sensitive to the size of the endowment ratio. If we believe that the capital service flow version is the correct model to use, then our ultimate assessment of the value of adopting a consumption tax will

4. When the price of capital decreases, as it does in all of these simulations, the price of value-added composite also drops. This gives an incentive to substitute away from the imported resource, with the degree of the response controlled by $\sigma_{VA,R}$. When this elasticity of substitution is 0.5, very little change occurs. However, in our other cases, the change is enough to lead to decreases of a few percentage points in the price of the imported resource.

Table 11.7 **Sensitivity Analysis of Consumption Tax for the Capital Service Flow Formulation**

	Welfare Effect	
	Additive Replacement	Multiplicative Replacement
1. $E_K = -1.0$, endowment ratio = 2	−$207.5 (−0.416)	−$292.6 (−0.587)
2. $E_K = -1.0$, endowment ratio = 5	−494.0[a] (−0.991)	−606.6[a] (−1.217)
3. $E_K = -1.0$, endowment ratio = 10	−635.6 (−1.275)	−764.4 (−1.533)
4. $E_K = -1.0$, endowment ratio = 4, foreigner pays gross-of-tax rental rate	452.5 (0.907)	162.5 (0.326)
5. $E_K = -0.5$, endowment ratio = 2	31.6 (0.063)	−30.8 (−0.062)
6. $E_K = -0.5$, endowment ratio = 5	−288.7[a] (−0.579)	−380.5[a] (−0.763)
7. $E_K = -0.5$, endowment ratio = 10	−490.0 (−0.983)	−603.3 (−1.210)
8. $E_K = -0.5$, endowment ratio = 5, foreigner pays gross-of-tax rental rate	544.5 (1.092)	370.9 (0.744)
9. $E_K = 0.0$, endowment ratio = 5	567.8 (1.139)	548.6 (1.100)
10. $E_K = -0.1$, endowment ratio = 5	233.5 (0.468)	188.6 (0.378)
11. $E_K = -4.0$, endowment ratio = 5	−720.8 (−1.446)	−863.2 (−1.731)

Note: Dynamic welfare effects in present value of compensating variations over time; all figures in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence.

[a]These results were reported previously in table 11.4.

depend upon the value we choose for E_K. We have highlighted the results for $E_K = -1.0$ and $E_K = -0.5$, under each of which the consumption tax is a losing proportion. However, table 11.7 indicates that if the value is close enough to zero, enough of the new capital stays at home that United States consumers benefit.

As can be seen from rows 4 and 8 of table 11.7, the results change dramatically when the foreigner is required to pay the gross-of-tax rental price of capital. The substantial losses in rows 1 and 5 become substantial welfare gains under this alternative model, as explained above. This result clearly demonstrates the possibility that the United States could gain by instituting a compensatory tax on capital income received from abroad. However, we must repeat three warnings for those who would advocate such a tax. First, these results arise only in this version of the

model. Second, they occur only when we study a consumption tax. Third, we have ignored the possibility of retaliation.

For our capital good formulation, we report only sensitivity analyses on Z_1 and the endowment ratio in table 11.8, because under the consumption tax, the United States saves abroad, but no foreign saving occurs in the United States. Consequently, Z_2 and Z_3 are immaterial in this case. However, they have an effect in the integration cases reported below, where the capital good flow is in the opposite direction. Table 11.8 reveals that our results are rather sensitive to the value of Z_1, but are quite insensitive to the endowment ratio values.

The consumption tax results certainly raise the possibility that a tax policy that appears to improve efficiency in a model of a closed economy may reduce efficiency in a model with an open world capital market. The intertemporal efficiency gains implied by the move to a consumption tax are more than offset by the misallocation of capital between the domestic and foreign economies. This result is due to our assumptions that the

Table 11.8 **Sensitivity Analysis of Consumption Tax for the Capital Good Flow Formulation**

	Welfare Effect	
	Additive Replacement	Multiplicative Replacement
1. Z_1 = 250, endowment ratio = 2	−$37.5 (−0.075)	−$52.9 (−0.106)
2. Z_1 = 250, endowment ratio = 5	−36.3[a] (−0.073)	−52.1[a] (−0.104)
3. Z_1 = 250, endowment ratio = 10	−33.9 (−0.068)	−50.7 (−0.102)
4. Z_1 = 50, endowment ratio = 2	238.1 (0.477)	225.1 (0.451)
5. Z_1 = 50, endowment ratio = 5	233.9[a] (0.469)	222.5[a] (0.446)
6. Z_1 = 50, endowment ratio = 10	235.2 (0.472)	218.4 (0.438)
7. Z_1 = 10, endowment ratio = 5	466.7 (0.936)	450.7 (0.904)
8. Z_1 = 100, endowment ratio = 5	105.6 (0.212)	92.1 (0.185)
9. Z_1 = 1000, endowment ratio = 5	−145.6 (−0.292)	−160.9 (−0.323)

Note: Dynamic welfare effects in present value of compensating variations over time; all figures in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence ($49 trillion).

[a]These results were reported earlier in table 11.4.

capital flows are zero in the base case and that the corporation income tax is left in place. The new saving incentives created by the adoption of a consumption tax induce individuals to save abroad where the social rate of return is lower than for domestic investments. The corporation income tax is the primary cause of this misallocation.

The sensitivity of our open-economy results to our capital flow elasticity parameters argues that these figures should be the subject of econometric investigation. While we have not pursued such a course ourselves, we hope that the profession can narrow the range of reasonable estimates so that the model's predictions can be made with more precision and confidence.

11.6.3 Corporate Tax Integration

In table 11.9 we present further analyses of corporate and personal tax integration in the United States, using the alternative external sector variants. Under the standard variant of the model, this policy produces gains of $418 billion with additive replacement and $311 billion with multiplicative replacement. These gains are between 0.5 and 1 percent of

Table 11.9 **Further Analysis of U.S. Corporate and Personal Tax Integration**

	Welfare Effect	
	Additive Replacement	Multiplicative Replacement
1. Central case—constant elasticity, no Armington	$418.2 (0.839)	$310.6 (0.623)
2. Central case—constant elasticity with Armington	417.0 (0.836)	314.0 (0.630)
3. Capital service flow version		
A. $E_K = 0.5$	1281.2 (2.569)	1244.8 (2.497)
B. $E_K = -1.0$	1415.2 (2.838)	1386.1 (2.780)
4. Capital good flow version		
A. $Z_2 = 50{,}000$; $Z_3 = 0.5$	611.0 (1.225)	514.9 (1.033)
B. $Z_2 = 100{,}000$; $Z_3 = 0.5$	794.4 (1.593)	708.0 (1.420)
C. $Z_2 = 50{,}000$; $Z_3 = 0.25$	1044.6 (2.095)	971.6 (1.949)
D. $Z_2 = 50{,}000$; $Z_3 = 1.0$	431.4 (0.865)	324.5 (0.651)

Note: Dynamic welfare effects in present value of compensating variations over time; all figures in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence ($49 trillion).

Table 11.10 **Changes in the Relative Price of Capital as a Result of Integration of the Corporate and Personal Income Taxes Model Variant**

Period	Constant elasticity, no Armington	Constant elasticity with Armington	Capital service flow $E_K = -1.0$	Capital good flow $Z_2 = 50{,}000$; $Z_3 = 0.50$
1	1.208	1.207	1.029	1.204
2	1.188	1.187	1.027	1.174
3	1.171	1.170	1.025	1.151
4	1.157	1.157	1.023	1.133
5	1.146	1.145	1.022	1.120
6	1.136	1.136	1.020	1.110
7	1.128	1.128	1.019	1.102
8	1.121	1.121	1.018	1.096
9	1.116	1.116	1.017	1.092
10	1.111	1.111	1.016	1.088
11	1.107	1.107	1.016	1.086

Note: All results based on additive replacement for equal revenue yield.

the total present discounted value of welfare. The results are virtually identical for the Armington version of the model. This is true not only for the aggregate welfare measure, but also for many of the detailed results. One can see from table 11.10 that the paths for the relative price of capital are very similar in the two cases.

Once again, it is the capital service flow version of the model that is the least similar to the other versions. With capital service flows, the welfare gains from integration are very large, in excess of 2.5 percent of total welfare. In this case the United States rents capital services from abroad, because integration results in an increase in the price of capital. This contrasts with the consumption tax case. Residents of the United States gain significantly from this transaction, since they pay the net-of-tax return. These rentals are very large. By the final equilibrium period, they amount to nearly $100 billion, compared with the rental value of the domestic capital stock of about $660 billion. These substantial supplies of capital from abroad are the reason that the relative price of capital services increases so much less under this version of the model than under all of the other versions. However, this does not appear to affect domestic capital accumulation very greatly. The incremental saving brought about by the policy change is about 80 percent as great in the capital service flow version as in the standard version. (In each case, the incremental saving is less than half as great for the policy of integration as for the consumption tax.)

Because the price of capital services does not rise as far under the capital service flow version, there are some differences among the model

variants in the sectoral allocation of production. Under the standard version of the model, the relative outputs of lightly taxed, capital-intensive industries such as agriculture and real estate are reduced for two reasons. First, these industries are less attractive after the tax changes because they now shoulder a relatively greater portion of the tax burden. Second, they suffer because of the relative increase in the price of capital services. Under the capital service flow version of the model, the second of these effects is greatly reduced, such that agriculture retains its share of output almost completely, and real estate only suffers about two-thirds as great a relative drop as under the standard version of the model. Similar reasoning would imply that heavily taxed, labor-intensive industries would increase their relative output and that the increase would be greater under the standard version of the model. Indeed, this occurs in many industries.

In table 11.9 we also provide sensitivity analysis on the welfare gains from corporate tax integration in the capital goods flow model. The parameters Z_2 and Z_3 control the strength of the capital inflow response to the increase in the price of capital in the United States. For values of Z_2 and Z_3, which seemed to us to provide believable responses by the foreigner, integration always causes a large welfare gain. Our reading of table 11.9 is that, despite some sensitivity to the values of these parameters, integration under the capital good version seems to yield gains in the neighborhood of 1 percent of the total present value of welfare.

11.6.4 Value-Added Tax

In table 11.11 we present results from our analyses of four different forms of value-added tax for the United States. We model an origin-based VAT as an equal-rate factor tax on both primary factors and a destination-based tax as an equal-rate final sales tax on expenditures in the United States. Under the income-type VAT, all goods are taxed, while only current consumption goods are taxed under the consumption-type VAT. We model the latter feature through a saving deduction for the origin-based VAT of the consumption type. In the case of the destination-based VAT, we model an income-type tax as a tax on all sixteen consumer goods and a consumption-type tax as a tax on the fifteen consumer goods other than saving. We impose equal revenue yield through additive or multiplicative scaling of the income tax. Since the VAT leads to an increase in revenue, the equal yield tax changes are *decreases* in personal tax rates. Therefore, the gains from the various types of VAT are greater (or the losses smaller) under multiplicative replacement. This contrasts with both integration and the consumption tax, under which tax increases were necessary in order to preserve yield equality. Not only does multiplicative replacement lead to better outcomes than additive replacement for the VAT, but the differences are substantial. This is because for the 10

Table 11.11 Welfare Effects of Introducing 10 Percent VAT of Differing Types

	Central case—constant elasticity, no Armington (1)	Central case—constant elasticity with Armington (2)	Capital service flow (3)		Capital good flow (4)
			$E_K = -0.5$	$E_K = -1.0$	
Income-Type VAT					
Origin basis					
Additive	−34.8	−35.4	230.6	278.4	−515.3
	(−0.070)	(−0.071)	(0.463)	(0.558)	(−1.033)
Multiplicative	192.3	186.2	390.6	425.7	−372.6
	(0.386)	(0.373)	(0.783)	(0.854)	(−0.747)
Destination basis					
Additive	−34.8	−35.4	209.8	253.5	−461.4
	(−0.070)	(−0.071)	(0.421)	(0.508)	(−0.925)
Multiplicative	192.3	186.2	374.3	406.8	−320.7
	(0.386)	(0.373)	(0.751)	(0.816)	(0.643)
Consumption-Type VAT					
Origin basis					
Additive	268.6	251.8	127.5	93.9	136.4
	(0.539)	(0.505)	(0.256)	(0.188)	(0.274)
Multiplicative	489.3	464.1	265.3	219.8	284.7
	(0.981)	(0.931)	(0.532)	(0.441)	(0.571)
Destination basis					
Additive	268.6	251.8	136.2	108.4	130.6
	(0.539)	(0.505)	(0.273)	(0.218)	(0.262)
Multiplicative	489.3	464.1	284.3	242.7	278.2
	(0.981)	(0.931)	(0.570)	(0.487)	(0.558)

Note: Dynamic wefare effects in present value of compensating variations over time; in billions of 1973 dollars. The numbers in parentheses represent the gain (or loss) as a percentage of the present discounted value of consumption plus leisure in the base sequence ($49 trillion).

percent VAT that we consider here, the tax reductions for equal yield are very substantial. In the case of the income-type VATs, marginal income tax rates are reduced by about 40 percent (for multiplicative replacement) and about ten percentage points (for additive replacement). For the consumption-type VATs, the rate reductions are about 35 percent and nine percentage points. This is the general order of magnitude of the tax changes for equal yield in all periods for all formulations of the model. Of course, if we were to consider a smaller VAT, the rate reductions would be smaller and the difference between additive and multiplicative replacement would not be as great. We restrict our attention here to 10 percent VATs for purposes of simplicity.

The changes in welfare resulting from the VAT are relatively small when compared with the results of corporate tax integration or the consumption tax. Whereas the latter changes remove some of the most heavily distortionary portions of the tax system, the VAT is designed to be a nondistortionary tax, except for the effects on labor supply and saving. Therefore, in the versions of the model with no international capital flows, the main welfare improvements come from the reductions in marginal income tax rates or from the reduction in intertemporal distortion resulting from the consumption-type VAT. The neutrality between the origin basis and the destination basis holds exactly for the formulations with no capital goods, and nearly so for the other cases.

In the versions of the model with no international capital flows, and in the capital good flow case, the welfare gains resulting from the income-type VAT runs are generally smaller than those resulting from the corresponding consumption-type VAT simulations. The gains are smaller because the income-type VAT inefficiently distorts individuals' consumption-saving decisions more than the consumption-type VAT, since the former tax applies to investment goods (as well as consumption goods) and in effect taxes saving. For instance, in the standard version of the model with additive replacement, the consumption-type VAT leads to a 6.6 percent increase in saving in the first period, while the income-type VAT causes a 7 percent decrease. These patterns continue in later periods. These changes in saving behavior lead to predictable changes in the relative price of capital. In the case of the income-type VAT, this price rises from about 1.009 in the first period to about 1.054 in the eleventh equilibrium. The consumption-type VAT causes the price of capital to fall from 1.004 to 0.965. These changes are small compared to those caused by the consumption tax on corporate tax integration but they do help explain the welfare results in the VAT simulations.

There is one exception to this general result. In the capital service flow case, the gains under an income-type VAT are larger than under the consumption-type VAT. Because of the movements of the relative price of capital, capital is rented to the United States under the income-type tax and from the United States under the consumption-type tax. Since, as discussed earlier, those offering capital overseas receive only the net-of-tax price of capital as compensation, the direction of the capital service flow is favorable to the United States under the income-type VAT, and unfavorable to the United States under the consumption-type VAT. The favorable effect under the income-type tax more than compensates for any adverse impact related to the tax's distortion of consumption-saving decisions.

The results of table 11.11 show that a consumption-type VAT is welfare improving in the open capital markets formulations, whereas earlier we saw that a consumption tax implemented as an 80 percent savings deduc-

tion reduces welfare in the same environment. The difference in results can be attributed to the fact that saving is still taxed under the VAT (although at a reduced rate after the equal yield adjustments), and to the fact that the incidence of a VAT differs from that of an expenditure tax. The high-bracket households, those who do most of the saving, have far more incentive to increase savings with the expenditure tax, given our specifications of the two experiments. Therefore, our VAT simulations entail much smaller capital outflows and social loss.

We view the value-added tax as it exists today as a particular European response to European problems of tax administration and the structural objectives of international economic integration in the EEC. What is not clear is whether the European experience is especially relevant to the problems of the United States. It does not seem that foreign trade concerns provide a legitimate reason for the United States to introduce a VAT. We have seen that the concern over the difference between origin-based and destination-based taxes is somewhat misplaced. In addition, there is no need to tie an origin or destination basis to a particular type of tax. For example, if the United States wanted to countervail the destination-based VAT in the EEC with a destination-based tax in the United States, that could be done equally well with a destination-based retail sales tax. Nevertheless, the results in table 11.11 indicate that a consumption-type VAT leads to welfare gains under every one of the foreign trade formulations. They indicate that a broadly based VAT that replaces existing distortions is worth considering.

11.7 Conclusions

In this chapter we have described four alternative external sector formulations that can be used to represent external sector behavior in our general equilibrium tax model for the United States. We consider two formulations of merchandise trade behavior using constant elasticity excess demand functions for the behavior of the foreign sector. We also consider internationally mobile capital service and capital goods.

Under these different formulations, we reinvestigate two policy alternatives considered in earlier chapters: consumption tax and integration of the personal and corporate income taxes.

Our results indicate that the different external sector formulations make some difference to the results of our model. The most pronounced changes result from the capital service flow formulations. Each of the policies that we investigated appears to have the potential to generate substantial capital service flows between the United States and abroad. When the net flow is from the U.S. to foreigners, the United States is adversely affected since those offering capital receive only the net-of-tax rental price.