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U.S. Adjustment in the 1990's

A CGE Analysis of Alternative Trade Strategies

Kenneth Hanson
Sherman Robinson
Stephen Tokarick

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Abstract

This paper investigates the implications for the structure of the U.S. economy of a reduction in the U.S. trade deficit. We explore two alternative adjustment scenarios. First, we assume an environment of successful world trade liberalization. An alternative view is that the world economy will lapse into a protectionist environment. We use a 30-sector computable general equilibrium (CGE) model of the United States to analyze the impact of these two scenarios. When analyzing the protectionist scenario, we do a variety of experiments designed to explore the impact of protectionist policies on the U.S. economy.

Keywords: CGE analysis, general equilibrium analysis, trade liberalization, protectionism, tariffs.

The Authors

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Summary

Macro economists generally agree that the U.S. trade deficit will be substantially reduced over the next decade. This paper investigates the implications for the structure of the U.S. economy of such a reduction. We explore two alternative adjustment scenarios. First, we assume an environment of world trade liberalization, with successful resolution of the Uruguay round of GATT negotiations. In this environment, the United States pursues a strategy of export-led growth, with a significant real devaluation and rapid expansion of exports, including agriculture. An alternative view is that the current round of GATT negotiations will end in failure and the world economy will lapse into a protectionist environment. In the second scenario, the United States is assumed to adopt protectionist policies to improve the trade balance and pursue an inward-looking growth strategy.

We use a 30-sector computable general equilibrium (CGE) model of the United States to analyze the impact of these two scenarios. The model includes significant detail in the agricultural sectors, including explicit specification of agricultural support programs. The CGE model is benchmarked to a 1988 base. The first adjustment scenario starts from a set of macroeconometric projections of the U.S. economy to 1991 and 1995 that incorporate a fall in the trade deficit and an assumed improvement in the world trade environment. These projections provide exogenous macro variables for the CGE model. The CGE model is then solved for the 2 forward years and provides projections of the structure of the U.S. economy, given the macro projections. Next, we model the alternative scenario in which the United States adjusts by means of import protection with a shrinking volume of trade. In analyzing the protectionist scenario, we do a variety of experiments designed to explore the impact of protectionist policies on the U.S. economy.

U.S. Adjustment in the 1990's

A CGE Analysis of Alternative Trade Strategies

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Introduction

In spite of the enormous current U.S. trade deficit, many macro economists project that the current account will move back into surplus in the 1990's. This view rests on a scenario that projects a significant real devaluation and rapid growth of U.S. exports. This view, implicitly or explicitly, presupposes a successful resolution of many of the disputes currently being debated within the GATT and places the United States in an environment of expanding world trade. Alternatively, the current round of trade negotiations could end in failure and the world might then lapse into a protectionist environment. The mounting trade deficit has certainly unleashed protectionist sentiments in the United States as import-competing industries clamor for protection from foreign competitors. If enacted, extreme protectionist policies might well induce retaliatory measures from our major trading partners, ultimately forcing the United States to adjust in an environment of shrinking world trade.

We investigate the implications of these different trade scenarios on the structure and performance of the U.S. economy. We use a 30-sector computable general equilibrium (CGE) model benchmarked on 1988 data. The first adjustment scenario starts from a set of macroeconometric projections of the U.S. economy to 1991 and 1995 that incorporate a fall in the trade deficit and improvement in the world trade environment. These projections provide exogenous macro variables for the CGE model. The CGE model is then solved for the 2 forward years and provides projections of the structure of the U.S. economy, given the macro assumptions.

Next, starting from the 1995 projection, we model the alternative scenario in which the United States adjusts by means of import restrictions with a shrinking volume of trade. In analyzing the protectionist scenario, we do two types of experiments designed to explore the impact of protectionist policies on the U.S. economy. First, we explore the impact of increased tariff protection for each of seven selected sectors, assuming in each case no other changes in tariffs. The underlying assumption is that protectionist political pressure is sector specific, and we analyze what happens if a single sector succeeds in obtaining protection, with no other changes in trade policy. Second, we impose an across-the-board tariff of 50 percent, which is added to existing tariffs in all sectors. In this case, the assumption is that there is a general increase in protectionist pressure resulting in something like the Smoot-Hawley tariff of 1930. With these experiments, we can compare the impact of sectoral protection with that of across-the-board protection.

The sector-specific and overall-protection experiments are run under varying assumptions about intersectoral capital mobility. For both policy experiments, we assume that capital is sector specific, a common assumption in recent trade theory literature, which emphasizes the role of industry-specific factors in determining the demand for protection.[1] We also repeat the overall-protection policy experiment assuming capital is freely mobile.

We describe the 30-sector CGE model used in the study, focusing on the model's treatment of foreign trade, including a new approach to modeling import demand functions. We then briefly review the theoretical properties of a model such as ours, with imperfect substitution for both exports and imports. We then present the forward projections to 1991 and 1995 and the protection experiments.

The CGE Model Structure

This section gives a brief overview of the structure of the model, focusing on the treatment of trade and omitting the details of the model equations. A complete description of the underlying CGE model can be found in Robinson, Kilkenny, and Hanson (forthcoming).

Supply and Demand

The model contains 30 sectors, each producing a composite commodity that can be transformed into an export good or a commodity sold only on the domestic market. Each industry's output is produced according to a constant returns to scale, constant elasticity of substitution (CES) production function which uses three primary inputs: labor, capital, and, in the agricultural sector, land. In addition, intermediate inputs are required according to fixed input-output coefficients. Sectoral input demands are derived from first-order conditions for profit maximization. Total endowments of land, labor, and capital are fixed, and factor prices are assumed to adjust to equate aggregate supply and demand in each factor market.

Aggregate domestic demand in the model has four components: consumption, intermediate demand, government, and investment (including inventory accumulation). The model has three households, with expenditure functions derived from a Cobb-Douglas utility function, yielding fixed nominal expenditure shares. Each household pays income taxes to the government and saves a proportion of its income, determined by fixed average propensities to save. Intermediate demand is calculated from total sectoral outputs, given the fixed, input-output coefficients. For the government, aggregate spending on goods and services is fixed, and its sectoral composition is given by fixed shares. Inventory demand by sector is a fixed proportion of domestic output.

Aggregate investment is either set exogenously from a macro model or is "savings driven." The difference between aggregate investment and inventory

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[1]For a survey of recent trade models emphasizing the role of industry-specific factors, see Magee (1978) or Mussa (1974). Findlay and Wellisz (1982) examine the role of specific factors in determining the demand for protection in a two-good general equilibrium model.

demand represents the total available funds for purchasing new capital goods; that is, fixed investment. Expenditure on investment goods by sector is a fixed share of the total funds available for investment, giving investment demand by sector of destination. Investment demand by sector of origin is translated from investment demand by sector of destination by using a capital composition matrix.

Aggregate savings is the sum of household saving, government saving, and foreign saving. Household saving is a fixed fraction of household income. Government saving is the difference between government revenue from income taxes, tariff revenue, and excise taxes, less government spending.

The model also contains a balance-of-payments constraint in that the value of imports at world prices must equal the value of exports at world prices plus foreign savings, net remittances, and foreign borrowing. In the experiments reported in this paper, we assume that the balance of trade for goods and nonfactor services, and hence foreign saving, is fixed exogenously and is given from macroeconometric projections.[2] In the CGE model, the real exchange rate adjusts to achieve equilibrium, given the fixed balance of trade.

The model makes the "small country" assumption on the import side, assuming that the United States cannot affect world prices of its imports. On the export side, we assume downward-sloping world demand functions for U.S. agricultural exports. Nonagricultural exports have fixed world prices.

Imports

A common feature in trade-focused CGE models is the Armington assumption that imported and domestic commodities are imperfect substitutes (Armington, 1969). This treatment is appealing in that it naturally accommodates the presence of two-way trade at the sectoral level, a common observation at the level of aggregation of multisector models. In the usual treatment, imports are combined with domestic commodities according to a constant elasticity of substitution (CES) aggregation function to form a composite commodity. Users of the composite commodity will choose an optimal combination of imports (M) and domestic commodities (D) so as to minimize total expenditure subject to the CES aggregation function. The optimal ratio of import demand to domestic demand for domestic goods is a function of their relative prices, the elasticity of substitution, and the share parameters in the import aggregation functions.

One drawback of using CES aggregation functions is that the expenditure elasticity of import demand is constrained to be one in every sector. Econometric work indicates that this constraint is statistically inappropriate.[3] Instead, for a number of sectors, we specified a more flexible functional form, the almost ideal demand system (AIDS).[4] We estimated the parameters of the AIDS function using sectoral time-series data for the 1970-86 period.

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[2]Foreign savings are fixed in world prices. The U.S. dollar value of foreign savings will change with the exchange rate.

[3]See, for example, Allston, Carter, Green, and Pick (1990).

[4]See Deaton and Muellbauer (1980) and Chalfant (1987) for discussions of the AIDS expenditure function.

The AIDS formulation of the Armington assumption yields an import demand function of the following form:

$$S_m = A_m + \gamma \cdot \ln(PD/PM) + \beta \cdot \ln(X/X0)$$

where S_m is the value share of imports in total expenditure on the composite commodity, A_m is the intercept term and represents the base year share when all prices equal 1, $\gamma \cdot \ln(PD/PM)$ captures the influence on the import share of changes in relative prices, and $\beta \cdot \ln(X/X0)$ captures the income effect. With X0 the real composite demand in the base year, the ratio (X/X0) is the growth in demand.

Since total expenditure on the composite commodity, P•X, must equal PM•M + PD•D, real composite demand, X, can be written:

$$X = (PM \cdot M + PD \cdot D)/P$$

The usual approach is to define P as a cost function of PD and PM, using either a Cobb-Douglas, CES, or translog functional form. We have chosen to use a CES function, mainly to be consistent with the treatment in the non-AIDS sectors.

The income elasticity of demand, ϵ_{ym}, and the elasticity of substitution between imports and domestic commodities, σ, are related to the parameters γ and β in the AIDS equation by the following formulae:[5]

$$\epsilon_{ym} = 1 + \beta/S_m$$

$$\sigma = 1 + \gamma/(S_m \cdot S_d)$$

where $S_d = (1 - S_m)$

As a flexible functional form, the AIDS formulation has some advantages over the CES import-aggregation function. It is, however, an approximation. While it has the advantage of allowing expenditure elasticities different from 1, it may be inappropriate for analyzing shocks that move import shares a large distance from the initial shares. In our application, we are analyzing scenarios in which total income changes a great deal, so we need a formulation that allows expenditure elasticities to differ from 1.

Exports

One treatment of export behavior that has become increasingly common in trade-focused CGE models is to employ a constant elasticity of transformation (CET) function. The CET function, whose form is analogous to the CES function, describes how sectoral production can be transformed into goods suitable for the domestic and export markets. Sectoral output is transformed into two different goods, each with its own price: PD for domestic output sold only on the domestic market and PE for exports (in domestic currency).

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[5]See Chalfant (1987) or Deaton and Muellbauer (1980) for a derivation of these expressions. Green and Allston (1990) discuss how the choice of the aggregate price index for the cost function will affect these formulae.

The small-country assumption can be retained for exports in that the domestic price of exports, PE, equals a fixed world price times the exchange rate and any subsidy rate, but the price of output for domestic use, PD, will no longer be tied to the world market price. Producers want to maximize revenue from sales subject to the CET transformation function. The optimal division of domestic output into part for export and part for domestic use will be a function of the ratio of PE to PD, the elasticity of transformation between the two uses, and the share parameters in the CET function.

Macro Balances

The CGE model includes the major macro balances: savings-investment, government deficit, and the balance of trade. How these balances are reconciled constitutes much of the subject matter of macroeconomic theory. In the literature on CGE models, the problem of achieving equilibrium among these macro aggregates is termed the "macro closure" problem.[6] For our purposes, the problem is relatively straightforward since we rely on a separate macroeconometric model to project the balance of trade, the government deficit, and aggregate investment. We "close" the CGE model by making these macro aggregates exogenous. Endogenously, the model solves for enterprise savings rates and the equilibrium real exchange rate to equilibrate savings-investment and the balance of trade.

In common with the neoclassical real trade model, the CGE model incorporates a functional relationship between the real exchange rate and the balance of trade. The real exchange rate is defined as the relative price of nontradables to tradables (PD for nontradables and PM and PE for tradables).[7] Ceteris paribus, an improvement in the balance of trade is associated with a real depreciation. The CGE model can solve only for relative prices. We choose as the numeraire price index the GDP deflator for the base forward run and the aggregate price of domestic goods sold on the domestic market for the protection experiments.[8] Given the choice of numeraire, the model solves for the equilibrium nominal exchange rate. That is, the CGE model takes as exogenous any two of the following three variables: the aggregate price level, the balance of trade, and the nominal exchange rate.[9] We use the macro model to project the aggregate price level and the balance of trade, and let the CGE model determine the equilibrium exchange rate.

When we model uniform protection, there is a large increase in government revenue from tariffs. In this case, we fix net government revenue and rebate the increased tariff revenue to households so that there are no macro feedbacks through the government account. When changing a tariff in a single sector, the change in tariff revenue is small, so we do not bother to adjust aggregate government transfers in those experiments.

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[6]Robinson (1989) surveys this literature.

[7]In the various tables, we report exchange rate indices. A decrease of the index indicates a depreciation of the exchange rate.

[8]For the single-tariff experiments, the two are effectively equivalent. For the overall protection experiments, the use of the domestic price index as numeraire makes the solution value of the exchange rate close to the real exchange rate since it is effectively an index of nontradable prices.

[9]See Melo and Robinson (1989) who sort out these relationships in a small analytic model that is close in structure to the CGE model.

Farm Programs

The U.S. CGE model contains a fair amount of detail in the agricultural sectors. The model also incorporates government programs to support agriculture. The standard approach to modeling government support programs in economywide models is to compute an ad valorem measure of the value of the programs to farmers and incorporate these as exogenous ad valorem rates into the behavioral equations of the model. Kilkenny and Robinson (1988) argue that this approach can lead to serious errors in estimating the impact on the economy of changes in agricultural programs and in estimating changes in the cost of such programs given changes in macro conditions.

In this model, following Kilkenny and Robinson (1990), we have taken a different approach. Instead of modeling agricultural programs with an ad valorem wedge, we have explicitly modeled the various programs. The model captures the major features of the deficiency payment program, the loan program (including government stocking operations through the Commodity Credit Corporation), and various trade restrictions on agricultural imports.

Theory of Protection

The U.S. CGE model assumes downward-sloping demand curves for exports in 4 agricultural sectors out of 30 sectors in all. The United States is assumed to behave as a "small" country on world markets for the other export sectors, and for all imports. In theory, tariff protection for the four exporting agricultural sectors might be welfare improving, given the ability to affect international prices and assuming no retaliation from other countries. However, the model also incorporates a variety of other market distortions, including existing tariffs, indirect taxes, and distortions in the factor markets. In general, we cannot predict the aggregate welfare effect of changes in protection. Given empirical work with a variety of models, however, we can expect that the aggregate welfare effects will be small.[10]

While aggregate welfare effects are liable to be small, protection can benefit particular groups in the economy at the expense of others. As demonstrated by Stolper and Samuelson (1941), interest in protection should form according to factor intensities. For example, if the import good is labor intensive, then labor has a clear interest in an import tariff since the increase in the price of the import good will raise the real wage, while lowering the return to capital. Thus, there exists a potential tension over trade policy among factor owners, with the interest determined by factor intensities.[11]

Alternatively, recent literature on rent seeking and pressure group models of trade policy formation has focused on models that incorporate a production structure characterized by specific factors.[12] With a sector-specific factor

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[10]For example, see the summary discussion in Srinivasan and Whalley (1986).

[11]There is also a "magnification effect" that commodity price changes have upon factor prices, an effect that generalizes to the multicommodity, multifactor case. See Jones and Scheinkman (1977) and Ethier (1974).

[12]The properties of the specific factors or Ricardo-Viner model are discussed in Mussa (1974), Mayer (1974), and Jones (1971). Empirical evidence in support of this view for the United States is presented in Magee (1978).

and a perfectly mobile factor, owners of the specific factor have a clear interest in protection for their own industry because such protection confers rents. They also have an interest in lower tariffs for all other industries because higher tariffs in other industries will cause the return to the specific factor in every industry but its own to fall. Thus, there exists a clear tension among owners of industry-specific factors over trade policy.

In our model, we do experiments in which capital is treated as sector-specific and, alternatively, as intersectorally mobile. We can thus explore both the factor-proportions version of the argument with all factors mobile and the sector-specific factor version. We do not, however, consider the case in which labor is also sector-specific, nor do we consider models of imperfect competition.[13]

The literature in trade theory describing the effects of protection has concentrated almost exclusively on the case where imports are perfect substitutes for domestically produced commodities. In a model where imports are imperfect substitutes for domestically produced commodities, the effect of an import tariff upon the price of the domestically produced substitute depends on the elasticity of substitution between the import and domestic good, the import share, and the elasticity of demand for the composite good. In general, the larger the elasticity of substitution between imports and domestic commodities, and the larger the import share, then the larger will be the effect of changes in tariffs upon domestic prices.[14] In the U.S. model, the elasticities of substitution between imports and domestic commodities are sufficiently large to expect protection to be effective, but we expect protection to have a smaller impact than it would have in a model in which commodities are perfect substitutes.

In addition, any tariff increase should introduce an incentive bias against exports. This notion is attributable to Lerner (1936), who showed in a model with perfect substitutes that an import tariff is symmetrical to an export tax in its effects. This result generalizes to an across-the-board tariff increase, which should provide a general bias against exports.

We are interested in measuring the degree of protection afforded to an industry as a result of the sector-specific tariff experiments. Looking solely at nominal sectoral tariffs can be misleading because they do not account for the fact that industries may use inputs that are themselves subject to tariffs. To get a more precise measure of industry protection, we calculate the effective rate of protection (ERP) for each industry. The ERP measures the degree of protection to sectoral value added associated with a

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[13]See Melo and Tarr (1989) for a related U.S. CGE model in which they explicitly consider the effect of protection on sectors in which there is imperfect competition.

[14]Melo and Robinson (1985) explore the relationships in a partial-equilibrium model. They show that if the elasticity of substitution between imports and domestic commodities is less than the elasticity of demand for the composite commodity, then the price of the domestically produced commodity will fall in response to a tariff increase and the tariff will fail to protect the domestic industry.

particular tariff structure.[15] In addition, we use the CGE model to calculate explicitly the change in value added due to tariff changes. In computing ERP's, we are interested only in comparing the effects of different tariff regimes. We thus make no attempt to take into account any nontariff barriers in the computation.

Base Projections to 1991 and 1995

The 30-sector CGE model for the United States is calibrated to a 1988 data base.[16] The calibration procedure is described in Robinson, Kilkenny, and Hanson (forthcoming). The sectoral and macro data were reconciled in the framework of a social accounting matrix (or SAM). Hanson and Robinson (1989) describe the procedure. An aggregate SAM for 1988 is presented in figure 1, and table 1 presents the sectoral structure of the economy.

From 1988, we project forward to 1995 in two steps. First, from 1988 to 1991 and then from 1991 to 1995. The projections for macro aggregates come from a small multicountry macro model developed by Malley (1990). As described above, the CGE model takes these macro projections as exogenous. Some indicators from the base projection are given in tables 2 and 3.

In terms of growth, the projection is conservative. Real GDP is projected to grow at 3.1 percent a year to 1991, then decline to 2.6 percent a year from 1991 to 1995. Total factor productivity growth is projected to account for less than half of total growth, a share somewhat lower than the longrun historical average. Government expenditure is projected to grow much more slowly than GDP.

The base projections to 1995 represent an optimistic trade scenario, projecting that the current account will move into surplus by 1995. An 18.1-percent nominal depreciation of the dollar (14.7-percent real depreciation) accompanies the movement to a trade surplus. Real exports and imports grow much faster than GDP, and the scenario essentially describes a successful policy of export-led growth.

Even with the rapid growth of exports, in 1995, the macro model projects a net foreign investment of $33.9 billion into the United States (table 2). There are two reasons. The balance of net factor services from abroad, which historically has been significantly positive for the United States, is projected to be negative by 1995. The rising ownership of U.S. assets by foreigners will generate a net flow of factor income to the rest of the world. Secondly, government interest payments abroad are also projected to increase

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[15]The formula we use for the effective rate of protection is from Corden (1966): $ERP_j = (t_j - \Sigma_i \theta_{ij} \cdot t_i)/(1 - \Sigma_i \theta_{ij})$, where t_j is the tariff on good j, θ_{ij} is the cost share of intermediate good i in final good j, and t_i is the tariff on input i.

[16]We started from a 1982 data base which was then updated to 1986 and 1988. Sectoral output and employment data for 1986 and 1988 are taken from unpublished Bureau of Labor Statistics data. The National Income and Product Accounts for 1986 and 1988 are used as macro control totals for aggregation of sectoral structure. The 1986 and 1988 National Income and Product Accounts data are from the Survey of Current Business, July 1988 and February 1989, respectively.

Figure 1 1988 U.S. social accounting matrix
(billions of current dollars)

Receipts or income	Expenditures or outlays: Suppliers: 1 Commodity	Suppliers: 2 Activity	Value added: 3 Labor	Value added: 4 Capital	Institutional actors: 5 Enterprise	Institutional actors: 6 Household	Institutional actors: 7 Government	Institutional actors: 8 Capital	Institutional actors: 9 World	Row totals
Suppliers:										
1 Commodity		3,894.1				3,226.4	968.4	773.7	412.5	9,275.1
2 Activity	8,726.7						11.0			8,737.6
Value added:										
3 Labor		2,995.5								2,995.5
4 Capital		1,469.2								1,469.2
Institutional actors:										
5 Enterprise	.2			1,469.2			82.8		24.1	1,576.4
6 Household			2,551.9		856.4		555.4		-1.0	3,962.7
7 Government	16.7	378.8	443.7		140.5	594.1			-40.9	1,532.8
8 Capital acct					579.5	142.2	-84.8		136.9	773.7
9 Rest of world	531.5									531.5
Column totals	9,275.1	8,737.6	2,995.5	1,469.2	1,576.4	3,962.7	1,532.8	773.7	531.5	

Table 1--Economic structure for 1988 base

Sector	Sectoral composition				Trade shares		Elasticities	
	Real output	Nominal value added	Real exports	Real imports	Real E/XD	Real M/XD	Import subst.	Import income
	Percent						Coefficient	
Dairy	0.3	0.2	-	-	-	-	-	-
Livestock	.9	.3	0.1	0.3	0.7	2.0	2.0	1.0
Cotton	.1	.1	.2	0	17.5	.2	4.0	1.0
Food grains	.1	.1	1.0	0	55.7	.5	4.0	1.0
Feed crops	.4	.3	.8	0	9.6	.4	4.0	1.0
Oil crops	.1	.2	1.3	0	44.8	.7	3.0	1.0
Sugar	0	0	0	0	0	0	.5	1.0
Other crops	.4	.4	.5	1.0	5.8	17.0	.5	1.0
Meat processing	1.0	.4	.9	.9	4.5	6.1	1.7	1.0
Dairy processing	.5	.2	.1	.2	1.2	2.9	1.7	1.0
Grain milling	.3	.1	.5	0	9.5	1.2	1.7	1.0
Prepared feeds	.2	.1	.1	0	2.1	.7	1.7	1.0
Corn milling	0	0	.2	0	16.1	1.1	1.7	1.0
Sugar processing	.2	.1	.1	.3	1.4	8.1	5.0	1.0
Soy milling	.2	.1	.7	.2	15.6	6.1	4.0	1.0
Misc. food	1.7	.7	.5	1.3	1.6	5.4	1.7	1.0
Mining & forestry	1.2	.9	2.7	.8	11.6	4.4	2.0	1.0
Petroleum	5.3	2.3	6.3	16.9	6.0	21.6	1.8	2.4
Construction	7.2	4.9	-	0	0	0	-	-
Chemicals	3.7	2.4	7.0	3.7	9.5	6.7	2.6	1.4
Other nondur. mfg.	4.8	3.5	4.9	15.2	5.1	21.5	2.6	1.4
Other durable mfg.	2.4	1.9	3.2	5.9	6.7	16.8	1.9	1.3
Metal mfg.	3.6	2.3	6.0	9.3	8.6	17.8	1.9	1.3
Machinery	4.0	1.9	13.9	5.4	17.6	9.2	1.9	1.3
Other electronics	2.5	1.9	10.8	5.2	21.6	14.0	1.9	1.3
Cons. electronics	.9	.6	4.4	14.4	25.0	110.0	1.9	1.3
Transp. equip.	4.4	2.6	15.0	14.4	17.1	22.2	2.8	.9
Trade & trans.	16.7	20.1	13.0	3.5	3.9	1.4	.2	.5
Finance	11.9	16.8	2.3	.1	1.0	.1	.2	.5
Other services	24.9	34.6	3.9	.9	.8	.3	.2	.5
Total	100.0	100.0	100.0	100.0	5.1	6.8	NA	NA
Agriculture	2.3	1.5	3.9	1.3	8.5	3.8	NA	NA
Food processing	4.1	1.7	3.0	3.0	3.6	4.9	NA	NA
Other industry	40.1	25.3	74.0	91.1	9.4	15.5	NA	NA
Services	53.5	71.5	19.1	4.6	1.8	.6	NA	NA

Notes: A "NA" denotes Not applicable. A "-" denotes no value. A "0" denotes a value less than 0.1 percent.

Table 2--Macroeconomic indicators, base projection

Item	1988-91	1991-95
	Annual growth rates (percent)	
GDP factor inputs and productivity:		
Real GDP, constant 1982 dollars	3.1	2.6
Labor	1.5	0.9
Capital	2.5	2.5
Land	4.0	1.2
Total factor inputs, weighted	1.8	1.4
Total factor productivity	1.3	1.2

	1988-91		1991-95	
	Real product	Real deflator	Real product	Real deflator
	Annual growth rates (percent)			
Demand aggregates:				
Consumption	2.2	4.1	2.3	3.7
Fixed investment	5.0	4.0	3.2	3.6
Inventory	3.3	4.4	2.4	3.4
Government	1.0	4.1	1.0	3.7
Exports	11.0	7.5	6.6	5.9
Imports	3.4	10.5	4.3	6.9
GDP	3.1	4.0	2.6	3.7

	1988	1991	1995
		Index	
Foreign trade indicators (1988=100):			
Real exchange rate index	100	91.8	85.3
Nominal exchange rate index	100	89.9	81.9
	Billions of current dollars		
Foreign trade balances:			
Nominal trade balance (excluding nfs.)	-118.3	-46.6	29.7
Nominal net factor services (nfs.)	24.1	-2.3	-13.0
Nominal current account balance	-94.2	-48.9	16.7
Nominal government and household net transfers & interest abroad	41.9	41.9	48.5
Nominal net foreign investment	-136.9	-92.1	-33.9
	Billions of 1982 dollars		
Real trade balance	-97.6	-52.1	-16.4

Note: "nfs." denotes net factor services.

in the 1990's, since the ownership of government bonds by foreigners has been increasing during the 1980's.

The base scenario is largely favorable for agriculture. Table 3 indicates the agricultural terms of trade improve and that agriculture's share of real GDP increases slightly, arresting the long-term decline observed in the post-war period. The cost of farm programs is projected to decline in both real and nominal terms. The decline is due to two factors. First, the various

Table 3--Agricultural sector indicators, base projection

Item	1988	1991	1995
		1988=100	
Agricultural terms of trade indices:			
Output prices	100	101.1	106.3
Value added	100	97.7	100.8
World export prices	100	97.9	95.1
		Billion dollars	
Agricultural program costs:			
Outlays to farmers--			
Current prices	6.5	9.4	5.9
1988 prices	6.5	8.3	4.5
Export subsidies--			
Current prices	1.0	1.4	2.1
1988 prices	1.0	1.3	1.6
Premiums from import quotas			
Current prices	.2	0	0
1988 prices	.2	0	0
		Percent	
Shares of real GDP:			
Agriculture	1.4	1.7	1.7
Livestock	.3	.3	.3
Crops	1.1	1.4	1.4
Food processing	1.9	1.9	1.9
Other industry	22.6	23.0	23.1
Services	74.1	73.4	73.3

Notes: The value added terms of trade measures relative value added per unit of output in agriculture relative to nonagriculture. The output and export price terms of trade measure agricultural prices relative to nonagricultural prices (Fohlin, Robinson, and Schluter, 1989).

Farm program costs as outlays to farmers consist of "recoverable" and "nonrecoverable" costs. They exclude disaster payments and reserve storage payments.

reference prices (target prices and loan rates) against which market prices are compared in determining agricultural support are projected to decline in real terms until 1991, thus lowering support levels. From 1991 to 1995, they are projected to rise only with average inflation. Second, export-led growth increases domestic agricultural prices, thus narrowing the gap between market prices and reference prices and lowering program costs.

Protection Experiments

Our fundamental macro assumption is that the U.S. trade deficit will be reduced during the early 1990's. The macro model projects a simultaneous reduction in both the government and trade deficits, which we incorporate into our model solutions for 1991 and 1995. We consider two alternatives through which the reduction in the trade deficit is accommodated in the economy. In the base run projections to 1995, the deficit is accompanied by a depreciation of the dollar, with no change in tariff structure. The alternative we consider in this section is that the United States increases protection against imports.

Using 1995 as a point in time when the trade deficit is eliminated with either strategy, we compare the protection experiments with the 1995 base run. It is impossible to predict the mix of quantitative and tariff restrictions that might emerge if the present round of GATT negotiations fails.[17] We use a simple approach of imposing a 50-percent tariff which is added to the existing tariff in affected sectors. The idea is not to project what might actually happen, but to explore the structural impact of following a protectionist regime. In all experiments, the balance of trade is fixed in world prices and the exchange rate adjusts to achieve equilibrium given the trade balance.

We perform two kinds of comparative static experiments. The first set of experiments imposes "sector-specific" protection. In seven separate experiments, a 50-percent tariff is added to the existing tariff in seven sectors, keeping all other tariffs at existing levels. In the second set of experiments, "overall" protection, all sectors receive a 50-percent tariff on top of existing tariffs. We consider two versions of the overall protection experiment: one in which sectoral capital is assumed to be sector-specific and one in which capital is assumed to be mobile among sectors. The idea behind the two sets of experiments is to compare what might happen when each sector seeking protection in its own self interest succeeds in having policymakers increase tariffs, leading to a situation in which all sectors simultaneously receive protection.

Sector-Specific Protection

In each sector-specific protection experiment, we perform a comparative static experiment from the 1995 base, individually adding a 50-percent tariff to each sector. The overall balance of trade is assumed unchanged, capital is sector specific, and labor is mobile across sectors.

Seven sectors are chosen for the single-sector protection experiments: dairy processing, sugar processing, crude and refined petroleum, other nondurable

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[17]For a discussion of some possibilities, see Bhagwati (1988) and Salvatore (1985).

manufacturing (which includes textiles and apparel), metal manufacturing (which includes iron and steel), consumer electronics (which includes computers and household appliances), and transportation equipment (which includes vehicles and aircraft). We choose these sectors because either they have large trade shares or they have historically achieved significant protection from imports.

Table 4 reports results from the experiments. The change in the exchange rate illustrates the macro impact, which is slight. Three sectors have a large enough import share so that increased sectoral protection leads to an appreciation of the exchange rate. Effects range from 1.7 to 3.4 percent.

The impact of sector-specific protection is primarily on the sector itself. The increase in protection is certainly significant. The effective rate of protection after the addition of a 50-percent tariff jumps dramatically to

Table 4--Sector-specific protection experiments

Item	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7
				Percentage change from 1995 base			
Exchange rate	0	0	0.4	2.6	0.5	1.7	3.4
Sectoral results:							
Production	0.8	7.0	3.0	16.3	10.7	71.8	18.1
Value added	1.9	16.7	6.4	18.9	11.8	77.0	18.9
Employment	1.4	11.8	10.0	23.6	13.5	85.1	21.4
Profit rate	2.8	25.0	4.1	10.4	4.9	32.3	8.5
Domestic price	.9	5.6	8.7	5.1	2.8	6.0	5.6
Composite price	2.1	4.0	15.0	12.1	7.6	25.5	10.0
Export price	0	0	-.4	-2.6	-0.5	-1.7	-3.4
Exports	-.9	-3.9	-8.3	1.0	4.4	56.0	3.5
Imports	-47.9	-81.4	-33.9	-45.2	-40.3	-27.7	-46.8
				1995 value in percent			
Effective rate of protection:							
1995 base	15.7	-1.1	.5	8.3	5.8	.8	.6
Experiment	211.3	115.9	79.8	96.2	102.1	109.6	103.9

Notes: Each experiment is a 50-percent tariff in a single sector. The values reported are for the sector in which the tariff is imposed. Terms for each experiment are:

Exp1: Tariff on dairy processing
Exp2: Tariff on sugar processing
Exp3: Tariff on petroleum (crude and refined)
Exp4: Tariff on other nondurable manufacturing (textiles, apparel, etc.)
Exp5: Tariff on metal manufacturing (steel, fabricated metals, etc.)
Exp6: Tariff on consumer electronics (computers and appliances)
Exp7: Tariff on transportation equipment (vehicles, aircraft, etc.)

over 100-percent in five of the seven sectors.[18] While protection in every case leads to an increase in the domestic price, the increase is much less than the increase in the price of the imported substitute. With the exceptions of petroleum and dairy processing, at the new equilibrium, the percentage increase in production is much greater than the increase in domestic price. Consumer electronics is an especially dramatic case, with an equilibrium increase in production of 71.8 percent. It is also the sector with the highest import share.

The increased sectoral protection does generate an incentive bias against exporting. In every case, the ratio of the price on the domestic market to that on the export market (PD/PE) increases. In the four manufacturing sectors, however, the general increase in supply incentives due to the import protection actually leads to an increase both in output and in absolute exports, even though the change in relative prices leads to a fall in the sectoral export share.

The increased protection does benefit the affected sector in every case. Demand for the variable factor, labor, increases, leading to significant increases in employment in the protected sectors. The return to the fixed factor, capital, also increases significantly. Consumer electronics is again the most dramatic case, with profits increasing by 32.3 percent and employment by 85.1 percent. If labor were also modeled as sector specific, one would expect the sectoral wage to rise dramatically instead of employment. In any case, protection works in that it greatly benefits the protected sectors. The effect is least for dairy processing, in which quotas and other nontariff barriers cause the initial import share to be very small (2.9 percent), so there is little scope for further import substitution, regardless of the elasticity of substitution.

Interindustry flows link sectors, spreading the impact of protection among users of the output and suppliers of inputs. The suppliers of inputs to the protected sector gain from protection through an increase in demand. For instance, protection for dairy processing increases production and value added for dairy farmers and feed crop growers. Sectors that compete for the same inputs as those used by dairy farmers, such as livestock competing for feed crops, experience a fall in production and value added from the protection. The higher costs of inputs (feed crops) reduce value added to livestock producers and meat processors, but the effect is small relative to the gains of the dairy-related sectors.[19]

Those sectors which use the commodities of a protected sector as inputs have to pay a higher price, increasing their costs. The effects of the higher costs on the using industries are lower production and higher producer prices, with a net effect of reducing value added. For instance, the composite price paid by users of the commodity in the protected metal manufacturing sector increases by 7.6 percent, as given in table 4. The effects on other

[18]Note that ranking the sectors according to the percentage increases in sectoral value added due to the tariff does not give the same results as ranking them according to effective rates of protection.

[19]While the value added of both dairy processing and dairy farming goes up around 2 percent, the value added of feed crops only goes up by 0.2 percent, and the value added of livestock goes down by 0.1 percent. These results are not tabulated.

industrial sectors that use metal products, such as the machinery industry and the auto industry (not shown), are reductions in production of 2.5 percent and 4.3 percent, respectively, and an increase in producer price of 1 percent in each sector.

As seen by the sector specific experiments, those sectors with large import shares have a strong incentive to lobby for protection. The adverse effect of protection on other sectors is smaller, suggesting less incentive to try and block the protection. What happens when all sectors succeed in gaining protection is examined in the next section.

Overall Protection

In the overall protection experiments, all sectors receive a 50-percent tariff on top of any existing tariff. As discussed above, the balance of trade, nominal investment, and nominal net government revenue are all fixed at their 1995 base run levels. As a result, the increase in overall protection is not allowed to change the macro aggregates. The model is designed to determine the structural impact of protection: its effect on the volume and structure of trade, demand, and production, and on the equilibrium exchange rate. We perform two versions of the overall experiment: one with sector-specific capital and one with mobile capital.

Aggregate indicators from the two overall protection experiments are given in table 5. There is a very small (0.25 percent) fall in real GDP, with a slightly greater loss when capital is sectorally mobile. In theory, one would expect the distortion to induce greater efficiency losses when more factors are free to adjust to the distorted incentives. The difference, however, is tiny and probably dominated by existing distortions which imply that we are moving among second-best equilibria.

In both experiments, the additional across-the-board 50-percent tariff causes a 13-percent appreciation of the dollar and about a 28-percent fall in both real exports and imports (calculating from table 5). Nominal exports and imports both fall about 37 percent. As theory suggests, a general tariff effectively imposes a tax on exports and leads to a reduction in the volume of trade. In macro terms, the effect is to change the growth scenario from export-led growth to domestic-demand-led growth.

Except for the agricultural sectors, the world prices of commodities are fixed, following the small-country assumption. The domestic export price index consequently goes down with the appreciation of the dollar. The domestic import price index goes up with the tariff and appreciation of the dollar. The change in the ratio of the domestic export price index to the domestic import price index measures the incentive bias against exporting induced by the tariff. This index of "effective trade bias" is defined by Bhagwati and Srinivasan (1979, p. 6). In both experiments, this index stands at 1.48.[20] While in these experiments the incentive bias arises only from the tariff, the effect of quantitative controls that yielded a similar fall in imports would yield a similar trade bias value. Any restriction on imports generates a corresponding tax on exports.

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[20]It would equal 1.5 for a 50-percent tariff, if it were not for the fact that the tariff leads to a reduction in agricultural exports and a rise in their world prices.

As discussed earlier, farm support programs are explicitly modeled in the CGE model. The agricultural sectors are adversely affected by overall protection. The agricultural terms of trade, which measure agricultural prices relative to prices in the rest of the economy, fall about 5 percent (for both experiments and for both output and value-added prices). Major farm programs (for example, deficiency payments and the loan program) are keyed to the difference between the market price and fixed reference prices (target price or loan rate). In this policy environment, the fall in agricultural market prices in the overall-protection experiments generates an increase in farm program costs. The aggregate cost of farm programs doubles (table 5) and the increase in agricultural subsidies reduces the fall in income in the agricultural sectors compared with the fall in value added (table 6).

Table 5--Aggregate indicators, overall protection experiments

Item	Base 1995	Overall protection: Fixed capital	Overall protection: Mobile capital
	Ratio to 1995 base		
Trade indexes:			
Real exchange rate index	100.0	112.1	112.9
Nominal exchange rate index	100.0	115.5	114.6
Domestic price of imports	100.0	128.6	129.5
Domestic price of exports	100.0	86.7	87.4
Effective trade bias	100.0	148.3	148.2
	Billion dollars		
Aggregate trade:			
Real GDP (constant 82 $)	4,802.4	4,787.0	4,779.3
Real exports (constant 82 $)	672.2	486.9	483.2
Real imports (constant 82 $)	702.0	504.3	499.5
Nominal exports (current $)	1,138.4	716.5	714.1
Nominal imports (current $)	1,110.8	692.6	690.0
	Ratio to 1995 base		
Agricultural terms of trade:			
Final demand	100.0	94.8	94.5
Value added	100.0	96.1	94.9
Exports	100.0	101.7	103.0
Imports	100.0	98.7	98.8
Agricultural program costs (outlays to farmers):	Billion dollars		
Current prices	5.9	11.3	11.0
1988 prices	4.5	8.6	8.4

Notes: Overall protection is modeled with a 50-percent tariff added to all imports, across the board. "Fixed capital" assumes capital is sector-specific. In "mobile capital," both capital and labor are mobile across sectors.

Table 6--Sectoral effects of overall protection with sector-specific capital

Sector	Real			Nominal		Employment
	Output	Exports	Imports	Value added	Sector income	
	Percentage change from 1995 base run					
1 Dairy	1.7	NA	NA	3.8	4.0	4.8
2 Livestock	2.4	-17.9	-42.7	4.8	5.5	5.9
3 Cotton	2.3	-11.1	-70.3	-10.7	-3.6	1.2
4 Food grains	-.6	-2.7	-77.9	-24.7	-11.6	-4.5
5 Feed crops	1.6	-6.8	-75.3	-17.4	-7.5	-1.2
6 Oil seeds	-7.3	-11.9	-63.4	-18.9	-19.0	-11.7
7 Sugar	5.2	NA	-8.1	2.6	2.6	5.9
8 Other crops	.4	-20.5	-10.2	-5.2	-5.2	-.6
9 Meat processing	1.4	-20.8	-35.5	-.6	-.6	2.3
10 Dairy processing	1.5	-22.3	-34.4	-.5	-.5	2.4
11 Grain milling	-1.6	-21.4	-36.5	-7.1	-7.2	-2.6
12 Prepared feeds	1.8	-18.9	-37.2	.1	.2	2.9
13 Corn milling	-2.3	-16.7	-39.7	-8.5	-8.5	-3.6
14 Sugar processing	5.3	-24.2	-67.8	8.3	8.3	8.8
15 Soy milling	-3.4	-22.0	-64.7	-10.7	-10.8	-5.4
16 Misc. food	-.2	-26.1	-32.3	-2.9	-4.0	-.3
17 Mining & forestry	-3.5	-27.0	-37.3	-7.7	-8.1	-5.5
18 Petroleum	-5.9	-26.3	-28.9	-14.9	-15.9	-18.8
19 Construction	-2.1	-26.9	NA	-6.0	-6.1	-2.9
20 Chemicals	-.6	-26.1	-41.9	-4.3	-4.5	-1.0
21 Other nondur. mfg.	9.8	-21.1	-32.4	7.9	7.7	14.0
22 Other durable mfg.	2.1	-23.7	-30.9	-1.2	-1.3	3.0
23 Metal mfg.	-.2	-26.2	-30.8	-3.8	-3.9	-.2
24 Machinery	-11.1	-35.7	-27.8	-14.9	-15.1	-12.5
25 Other electronics	-7.5	-31.9	-29.2	-11.3	-11.4	-8.5
26 Cons electronics	19.9	-13.9	-19.2	17.2	17.1	23.3
27 Transp. equip.	-7.1	-35.9	-30.8	-10.8	-11.1	-8.3
28 Trade & transport.	-1.1	-22.5	-13.2	-4.8	-5.0	-1.6
29 Finance	1.5	-21.6	-12.9	-.6	-.7	5.0
30 Other services	.9	-21.3	-13.4	-2.6	-2.7	1.2
Agriculture	.9	-10.3	-18.7	-9.7	-5.9	.2
Food processing	.5	-22.0	-37.2	-2.0	-2.4	.9
Other industry	-2.7	-30.0	-28.9	-6.2	-6.4	-1.5
Services	.4	-22.1	-13.3	-2.8	-2.9	.5
Average	-.9	-27.6	-28.2	-3.8	-3.9	0

NA = Not applicable.

Note: Nominal sector income equals nominal value added net of subsidies and indirect taxes. Sectoral subsidies include farm income support programs. Nominal sectoral value added does not include changes in tariff collections.

Table 6 reports the structural impact of overall protection in the sector-specific capital case. In general, sectors with high import shares gain, while those with high export shares lose. Overall, the industrial sector loses. Consumer electronics is the largest gainer in percentage terms and also has the largest import share. Transportation equipment has high import and export shares and is a net loser. All the agricultural sectors that have significant export shares lose. The only agricultural gainers are dairy, livestock, and sugar. Cotton, feed crops, and other crops increase their output, but still have lower incomes because of the fall in prices. Overall, real agricultural output increases slightly, but value added and income fall. Three sectors have high import shares, but lose sectoral income nonetheless: petroleum, other durables, and metal manufacturing. These lose because they provide intermediate inputs to sectors whose outputs fall, and hence who generate less demand for intermediate inputs.

Note that aggregate nominal value added falls by 3.8 percent. This result is a statistical phenomenon. In the U.S. national income and product accounts, tariffs are included as part of value added in the trade services sector. In table 6, however, we do not report the large change in tariff collections, which amounts to about 3 percent of GDP, as part of the change in value added in this sector. The change in aggregate value added reported in table 6 thus appears larger than in the GDP accounts.

The structural impact of pursuing a protectionist trade strategy is quite dramatic, even with restrictions on factor mobility which limits the ability of the economy to respond to the changed incentives. Figure 2 compares the results for sectoral output of imposing overall protection with and without intersectoral capital mobility. Allowing capital mobility leads to a larger output adjustment in almost every sector. However, the differences are not large in most sectors.

Whether or not capital mobility is assumed, the effect of overall protection on economywide average wage and profit rates is negligible. In the mobile-capital experiment, the average profit rate fell by less than half a percent and the real wage did not change (numbers not tabulated). With sectorally fixed capital, there was no change in either the average wage or average profit rate. The theoretical argument indicating that protection will favor one factor over another appears to be empirically irrelevant in the United States. The probable reason is that, with extensive input-output linkages, changes in protection are diffused across the economy. The differences in factor intensities across sectors are simply not great enough to yield significant changes in average factor returns, even given fairly large changes in the sectoral structure of production.

The model results, however, do lend support to the notion that sector-specific factors gain significantly from protection. While there is clearly an incentive for individual sectors to seek protection, there are also risks. Figure 3 charts sectoral value added when there is a 50-percent tariff on each sector singly versus an across-the-board tariff. The differences are striking. Across-the-board protection is much less beneficial to these sectors. In four cases, the sign is reversed and the sector actually loses value added. These experiments indicate the fallacy of composition of protectionist arguments. Protection that benefits an individual sector only does so if other sectors are not also protected.

Figure 2 Overall protection experiments, sectoral output changes with sectorally fixed and mobile capital

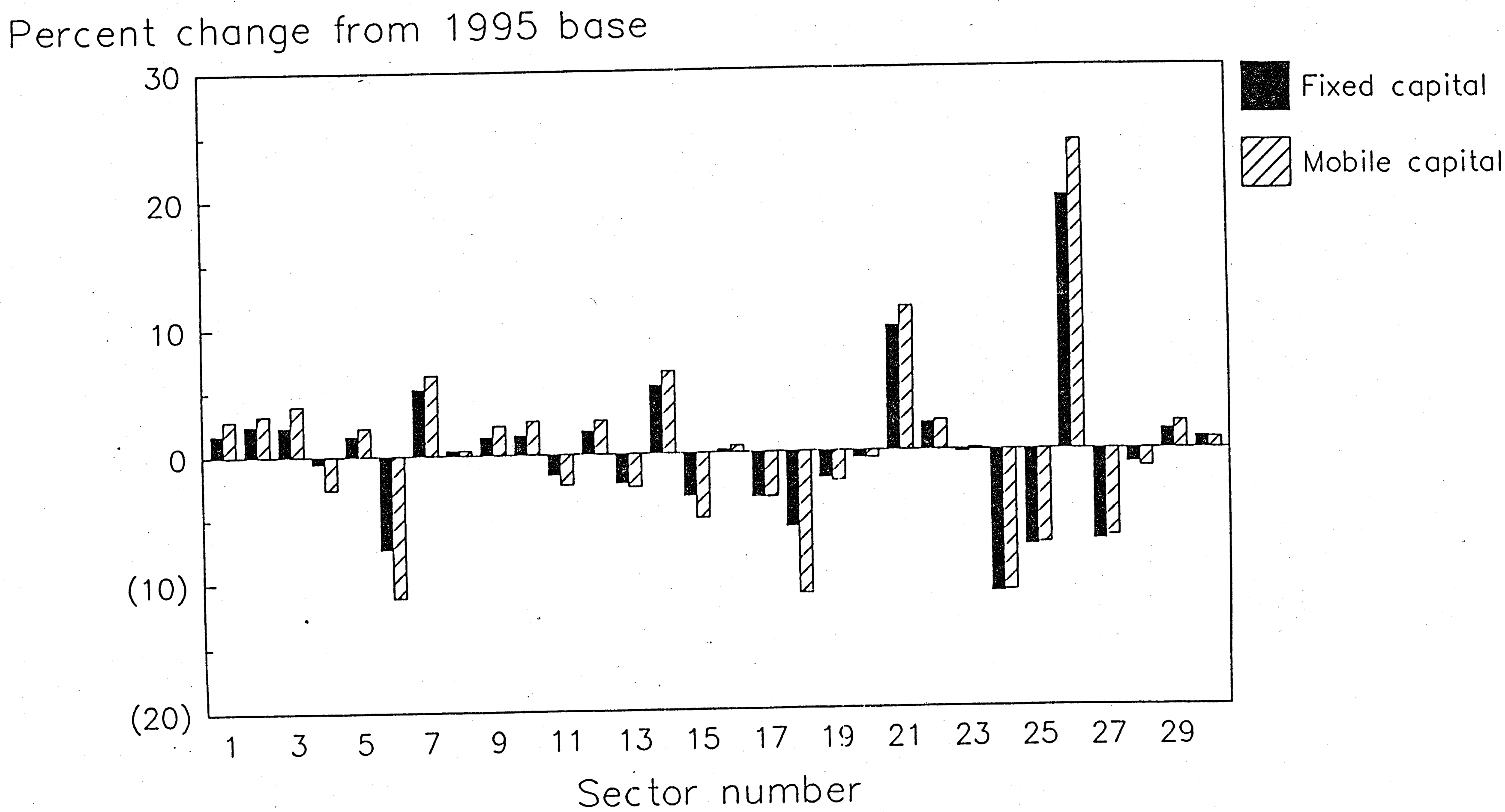
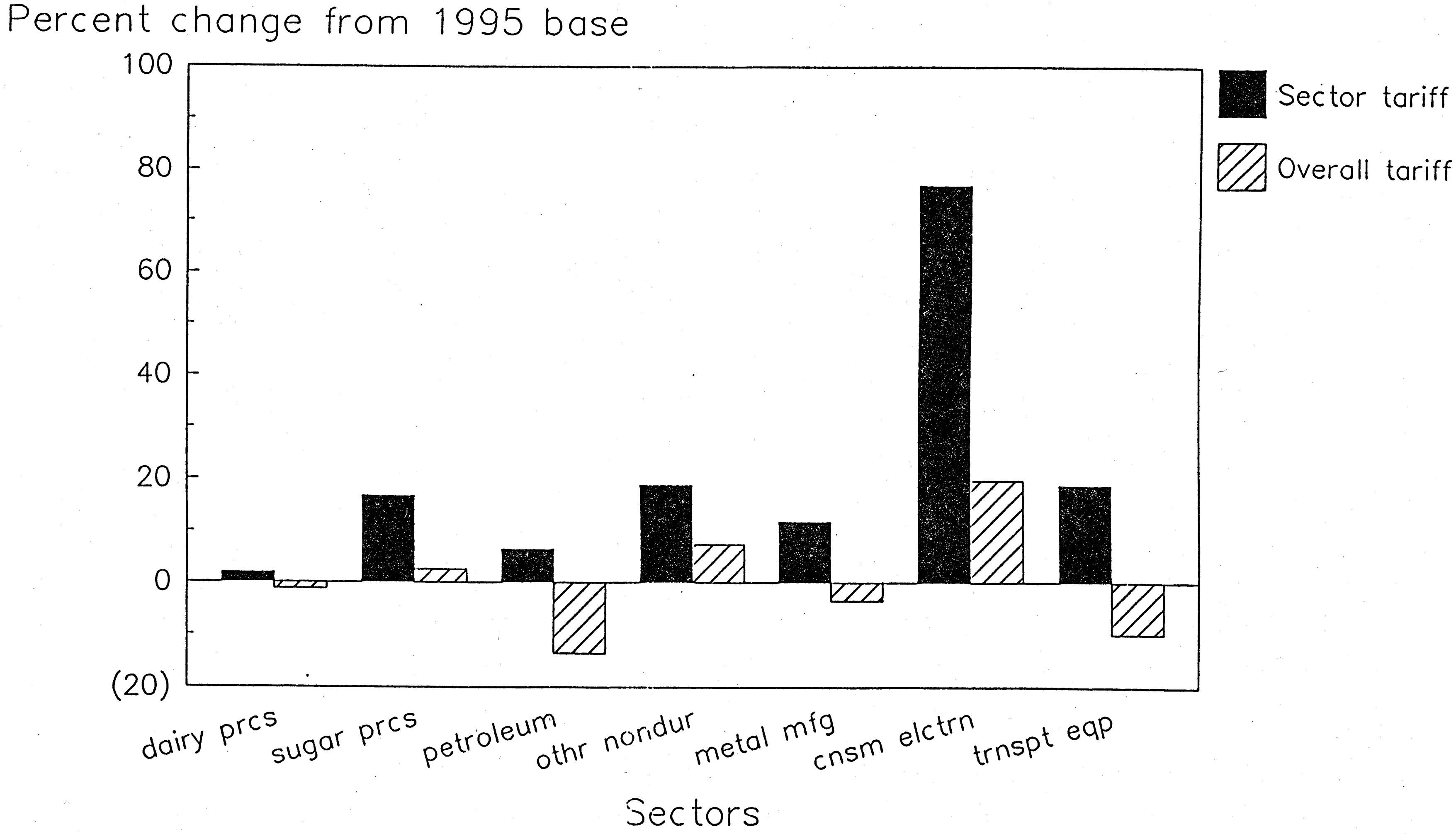


Figure 3 The impact of sector specific and overall protection on sectoral value added for seven sectors



Conclusion

The results from these experiments yield a few lessons for policymakers. The United States has undergone a variety of macro shocks in the 1980's, including dramatic increases in the Federal budget deficit and trade deficit. These shocks and concomitant policy reactions led to major changes in the real exchange rate, relative prices, volume of trade, and sectoral structure of production, imports, and exports. Current macro projections, which provide the starting point for our analysis, indicate continuing macro swings into the 1990's as the United States seeks to adjust its macro balances.

We have used the CGE model to trace out the implications of alternative forms of "structural adjustment" to the changing macro environment. Implicit in the macro projections is a fairly optimistic trade scenario in which the United States pursues an open trade strategy in an environment of liberal world trade. In this scenario, aggregate exports and imports grow faster than GDP and the economy pursues a successful strategy of export-led growth.

An alternative is that the world trading environment worsens and that the United States gives in to domestic protectionist pressures. Our experiments tracing out the implications of this scenario indicate a dramatic decline in the volume of trade, with a relative decline in aggregate industrial output and serious damage to exporting sectors, including agriculture. The cost of programs to support agriculture roughly double, as government support policies keyed to the difference between market and reference prices for agriculture kick in.

Our results also indicate that the existence of protectionist pressures is certainly understandable. Sectors clearly gain if they can achieve protection without any change in policies affecting other sectors. However, the risks are high. If lobbying for particular sectoral protection leads to a general increase in tariffs or restrictions on imports, the sectoral implications are much less beneficial or positively harmful. What works for one does not work for all.

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