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Chapter Author: Alan V. Deardorff, Robert M. Stern

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10 The Effects of the Tokyo Round on the Structure of Protection

Alan V. Deardorff and Robert M. Stern

In this paper, we use the Michigan Model of World Production and Trade to analyze the structure of protection in the United States and abroad as it was altered by reductions in tariffs and selected nontariff barriers (NTBs) negotiated in the Tokyo Round. We employ a methodology developed in Deardorff and Stern (1983b) which accounts for the protective effects of trade barriers in many countries simultaneously, both directly and indirectly through the exchange rate changes that these barriers may induce. In addition to calculating the effects of the Tokyo Round on the structure of protection, we also examine how our measures of protection correspond to alternative specifications of our data inputs and assumed technology, and to a number of economic variables and other characteristics of our model, including the resource flows that are calculated directly by the model.

The paper is organized as follows. We describe the Michigan Model briefly in section 10.1, our methodology in section 10.2, and data and results in sections 10.3 and 10.4. Some concluding remarks are given in section 10.5.

10.1 Description of the Model

The Michigan Model is a disaggregated, microeconomic model that we have developed in the past several years to analyze the effects of changes

Alan V. Deardorff and Robert M. Stern are associated with the Department of Economics and the Institute of Public Policy Studies, the University of Michigan.

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in tariffs and NTBs and a variety of other important variables.[1] The equations of the model are listed in the appendix. While a full description of the model is given in Deardorff and Stern (1981), some brief comments describing the model may nonetheless be useful here for those not familiar with our previous work.

The model incorporates supply and demand functions and market-clearing conditions for twenty-two tradable and seven nontradable industries in thirty-four countries.[2] There is also an aggregated sector representing the rest of the world. Exchange rates are assumed to be flexible in all the industrialized countries except New Zealand and pegged in most developing countries.

Supply and demand functions interact on both national and world markets to determine equilibrium prices, quantities traded and produced, plus the flexible exchange rates. Labor demand functions also determine employment in each industry and country. We abstract from such macroeconomic determinants of aggregate employment as levels of government spending, taxes, and the money stock. Instead, aggregate expenditure is adjusted endogenously to hold aggregate employment constant in each country.

Supply and demand functions were derived from maximization of profit and utility functions. These in turn were selected to permit a rich variety of behavior, but also to have parameters that could be either readily observed from available data or inferred from published econometric estimates. The current version of the model uses a base of 1976 data on trade, production, and employment for all thirty-four countries, plus tariffs in the industrialized countries. To describe technology, we use the 1972 input-output table for the United States and the 1970 national tables for the individual EEC-member countries and for Japan. The U.S. table is applied to the remaining industrialized countries. We use the 1970 input-output table for Brazil and apply this table to the other developing countries. Estimates of import demand elasticities and elasticities of substitution between capital and labor were obtained from the literature.

For want of a better measure, we represent existing NTBs in developed countries in terms of the fractions of 1976 trade that were covered by any kind of NTB in particular sectors and countries. We then model these sectors as less sensitive to tariff changes than would otherwise be the case. Specifically, the model includes, for each industry and country, an endogenous tariff-equivalent variable that reduces changes in imports to a fraction of what they would be without NTBs. That fraction is taken to be the fraction of trade not covered by NTBs in 1976. In addition, the model also includes several shift parameters in supply and demand functions that can be used to represent aggregate negotiated changes in NTBs as described below.

For developing countries, we have data on trade, production, and employment but no data on tariffs and NTBs. This is not serious since they will make few, if any, changes in policies as a result of the Tokyo Round. We do, however, capture elements of their existing NTBs by modeling a system of import licensing in most of these countries.

10.2 Conceptual Framework

Our conceptual framework[3] derives from the theory of effective protection, which is defined by Corden (1966, 22) as "the percentage increase in value added made possible by the tariff structure." Since our model treats prices as endogenous, it is well suited to the measurement of value added. But, more importantly, our model incorporates general equilibrium relations and takes into account the rather moderate degree of substitution between imports and home-produced goods that characterizes behavior in international trade.[4] We can thus provide a more realistic indication of the degree to which industries are protected than is possible using the simple partial equilibrium formula that was so popular in early studies of effective protection. Further, because of the multilateral and flexible exchange rate features of the model, we can capture the protective effects of both domestic and foreign tariffs, as well as the effects of changes in exchange rates.

To proceed more formally, let us define the value added per unit of an activity which produces a good j as:

(1) $$v_j = p_j^O - \sum_{i=1}^{n} a_{ij} p_i^I ,$$

where v_j is value added per unit in production of good j, p_j^O is the price that producers receive for their output of good j, p_i^I is the price they must pay for intermediate inputs of good i, and a_{ij} is the number of units of good i used in producing one unit of good j. Our objective is to calculate the "change in per unit value added" (CPVA) that will result from the implementation or change of some measure of protection. From equation (1), in proportional terms, this is

(2) $$\text{CPVA}_j \equiv \frac{\Delta v_j}{v_j} = \left(\frac{1}{1 - \sum_{i=1}^{n} b_{ij}} \right) \left[\frac{\Delta p_j^O}{p_j^O} - \sum_{i=1}^{n} b_{ij} \frac{\Delta p_i^I}{p_i^I} \right],$$

where

(3) $$b_{ij} = \frac{p_i^I a_{ij}}{p_j^O}$$

is the share of input i in the value of production of a unit of good j. The changes (Δs) in equation (2) can refer to the results of any protective policy one wishes to examine. Most often, they refer to the results of implementing an entire structure of tariffs, starting from a base of free trade. But they could just as easily be used to measure the effects of changing particular tariffs or groups of tariffs, or installing or removing a system of nontariff barriers.

Calculation of all of the price changes that appear on the right-hand side of equation (2) would normally be very difficult, though, of course, that is what our computational model is designed to do. In most previous studies of the structure of protection, however, the problem has been considerably simplified by assuming that all traded goods are infinitely elastically supplied at given world prices p_i^W. It follows, for imported goods, that the domestic prices p_i^D of both outputs and inputs are given by the world price plus the tariff. For ad valorem tariffs t_i, this gives us

$$p_i^D = (1 + t_i)p_i^W. \tag{4}$$

The price changes that result when these tariffs are levied, starting from tariffs of zero, are just the tariffs themselves, since the world prices are constant. Equation (2) then provides the following simpler measure of protection:

$$\text{ERP}_j \equiv \frac{\Delta v_j}{v_j} = \frac{t_j - \sum_{i=1}^{n} b_{ij} t_i}{1 - \sum_{i=1}^{n} b_{ij}}. \tag{5}$$

This is the formula used by Corden (1966) and many others to measure the protection due to a tariff structure. For convenience, we shall use the term, "effective rate of protection," to refer only to this simple calculation, and reserve the term "change in per unit value added," or CPVA, for the more accurate measure of protection defined in equation (2).[5]

As our derivation of (5) indicates, and as Corden himself acknowledges, the validity and usefulness of (5) depend on a number of assumptions, of which the following three will be of particular interest to us here:[6]

1. Goods are infinitely elastically supplied or demanded on world markets, so that tariff-exclusive prices are independent of the tariffs themselves.
2. Exchange rates are held constant.
3. Foreign tariffs are either constant or irrelevant.

Each of these assumptions plays in identifiable role in causing differences between ERP and CPVA. These differences were explained and verified using our model in Deardorff and Stern (1983b). Since they are important for interpreting the results in this paper, we shall review them here as well.

10.2.1 Exogeneity of Tariff-Exclusive Prices

For this to be true, two further assumptions are necessary. First, the country must be sufficiently small, as a participant in world markets, so that its changes in supply and demand do not affect world prices. For some countries this may be approximately true, but for the United States it most certainly is not. Thus, if the United States were to levy tariffs and consequently reduce its demand for imports, the world prices in affected sectors would fall and the U.S. domestic price would not rise by the full amount of the tariff. The precise implication of this phenomenon for calculation of protection in equation (2) depends on how the country's importance to world markets is distributed among outputs and inputs. But we would expect, in general, that by dampening the domestic price changes that occur, country size would tend to reduce somewhat the levels of protection.

The second assumption needed for price exogeneity is that domestic and foreign goods are perfect substitutes. If they are not, then even if the price of an import rises by the full amount of the tariff, the price of a corresponding domestic good will not. Thus imperfect substitutability will further dampen the price changes in equation (2) and reduce levels of protection below what would be calculated by the ERP.

Imperfect substitutability is also what warrants the distinction we made in equations (1) and (2) between input and output prices. Outputs are, by definition, domestically produced, while inputs will in general come from both imported and domestic sources. If the two are imperfect substitutes, with the prices of domestic goods varying by less than the price of imports as just suggested, then the prices of outputs will also vary by less than the prices of inputs. When, as we impose a structure of tariffs, all are tending to rise, this means that the positive term in (2) is dampened by more than the negative terms, and the level of effective protection is reduced algebraically compared to (5).

All prices are endogenous in our computational model. World prices are determined simultaneously by the interaction of all countries together, and no country is assumed ex ante to be small. Further, domestic and traded goods are distinct, with finite elasticities of substitution between them based on empirically estimated import elasticities. Thus from what we have said so far, we would expect our calculations of CPVA based on equation (2) to be both smaller in absolute value and more often negative than the effective rate of protection based on the Corden formula (5). This was confirmed by our numerical results in Deardorff and Stern (1983b).

10.2.2 Exogeneity of Exchange Rates

While Corden defined effective protection under the assumption of a fixed exchange rate, he recognized the inevitability of an eventual exchange rate change in response to the imposition or elimination of a complete structure of tariffs. He thus suggested a simple adjustment of all effective rates to take this into account. Such an ad hoc procedure is not necessary for us here, since our computational model can be solved for endogenous exchange rates along with everything else. Nor need the effect of the exchange rate change be quite so trivial as it was for Corden, since different sectors can be affected differently by exchange rates in our model.[7]

In general terms, both we and Corden expect exchange rate adjustment to alter the protection calculation as follows. When a country imposes tariffs in most industries, its trade balance is expected to improve. If the exchange rate is flexible, its currency will appreciate to restore equilibrium, and this will reduce the domestic prices of both imports and exports, leading to negative protection in those sectors which were least protected by the tariffs themselves. Thus, exchange rate flexibility reduces and makes more negative our measures of CPVA based on equation (2) as compared to analogous rates based on fixed currency values. Naturally, the opposite is true of the CPVA due to a general tariff reduction rather than an increase.

10.2.3 Exogeneity of Foreign Tariffs

Nothing in the concept of effective protection limits it to a country's own tariffs, though these are obviously the only policies that can be taken into account in the simplified formula (5). Industries also experience protective and antiprotective effects from the tariffs levied by other countries, and one might want to include them with a country's own tariffs in a complete analysis of the structure of protection worldwide. Whether to do so is largely a matter of choice, depending less on economic reasoning than on the question one wishes to answer. For our purpose here of analyzing the effects of the Tokyo Round of multilateral trade negotiations, the world view is clearly the most appropriate.

Presumably a country's own tariffs tend to protect its industries and foreign tariffs tend to play the opposite role. Therefore, we expect levels of protection to be even smaller and more negative when allowance is made for foreign tariffs. It thus appears that the modifications of the simple analysis that we have discussed here—endogenizing prices and exchange rates and allowing for foreign tariffs—all tend to reduce, either absolutely or algebraically, the levels of protection that we should expect.

10.2.4 Traded versus Nontraded Goods

The treatment of nontraded goods has always been a source of difficulty in calculations of effective protection. The problem is that the prices of nontraded goods are not pegged to any world prices as in equation (4). Corden (1966) describes two alternative procedures for handling them, neither of which is wholly satisfactory. One alternative is to include them with the traded inputs in both summations of equation (5), letting their tariffs in the numerator be zero. This would be valid only if the nontraded goods were themselves infinitely elastically supplied, so that their prices would be unaffected by the tariffs on traded goods. Since this is manifestly implausible, especially if the nontraded goods are themselves produced with traded inputs, Corden prefers the second alternative of including nontraded goods with value added, and thus excluding them from both summations in (5). This second alternative, which differs from the first only in the denominator, leaves us with no clear idea of which sectors are actually being protected by the levels of effective protection that we measure.

An important advantage of using our computational model to estimate protection via equation (2) instead of (5) is that none of this difficulty arises. From the model we have estimates of how all prices are affected by tariffs, and these include the prices of nontraded goods. Thus, we can include nontraded with traded goods in calculating (2), and the results refer clearly to the protection of value added actually employed directly in each sector. Protection of value added in nontraded sectors is handled in the same way.

Using the simple formula (5) to estimate effective protection of nontraded sectors, one would of course find their levels of protection to be negative. This results from the rise in the prices of traded inputs that are used in the nontraded sectors. In a general equilibrium context, however, this can be reversed. Tariffs on most tradable goods, especially if levied by all countries at once, tend to act like a consumption tax on tradables, raising their prices relative to nontradables. As demanders substitute toward nontradables their prices also tend to rise, and since the output price in (2) gets a larger weight than even the combined prices of the inputs, the nontradables in general may be protected positively. This phenomenon, that tariffs may afford positive protection to nontradable industries, is an important implication of a general equilibrium model that deserves to be studied further.

10.3 Data

The Tokyo Round of Multilateral Trade Negotiations (MTN) was concluded in April 1979. It marked the seventh round of multilateral reductions in trade barriers negotiated under the auspices of the General Agreement on Tariffs and Trade (GATT) since World War II. Tariffs on industrial products had last been reduced on a major scale in the Kennedy Round, which was concluded in 1967 and implemented over the subsequent five years. The Tokyo Round tariff reductions began in 1980 and will be phased in over a seven-year period. An even more noteworthy accomplishment of the Tokyo Round is the negotiation of a series of codes covering such NTBs as customs valuation, government procurement, import-licensing procedures, subsidies and countervailing duties, and product standards.

In Deardorff and Stern (1983a), we used our model to analyze the effects of the Tokyo Round negotiations on trade, employment, economic welfare, exchange rates, and domestic prices for the thirty-four countries and twenty-nine sectors covered by the model. To obtain the tariffs for use in the model, we began at the line-item level of the Brussels Tariff Nomenclature and aggregated by ISIC sector in each country, using own-country imports as weights for each of the twenty-two tradable sectors. This was done for both the pre-Tokyo Round tariff rates and the offer rates that were negotiated. The differences between these rates thus represent the negotiated changes in tariffs.

As mentioned above, because of the lack of information, we were unable to represent most existing NTBs in our model in an explicit manner to capture their protective effects. What we did was to calculate the fraction of trade covered by any kind of NTB in particular sectors and countries and to model these sectors as less sensitive to tariff changes than would otherwise be the case. This may not be too great a drawback for present purposes. Except for certain bilateral agricultural concessions and the liberalization of government procurement, whose effects we did model explicitly together with the tariff reductions,[8] the NTB codes that were negotiated do not lend themselves readily to quantification. Moreover, most of the existing NTBs affecting trade in agricultural products, textiles and clothing, footwear, iron and steel products, consumer electronic products, automobiles, and shipbuilding were exempted from the negotiations.

10.4 Results

The weighted average nominal tariffs by sector for pre- and post-Tokyo Round are shown in columns (1) and (4) of tables 10.1–10.3 for the United States, EEC, and Japan.[9] The rank order by sector is shown in parentheses. Thus, the sectors with the highest nominal tariffs in the United States were wearing apparel, textiles, leather products, nonmetallic mineral products, and glass and glass products. In the EEC, the highest nominal tariffs were in wearing apparel, food products, footwear, chemicals, and transport equipment. In Japan, the highest nominal tariffs were in food products, agriculture, footwear, wearing apparel, and nonelectric machinery.

Levels of the effective rate of protection based on formula (5) for pre- and post-Tokyo Round are shown in columns (2) and (5) of tables 10.1–10.3, together with the sector rankings.[10] We used here the first of Corden's alternatives for handling nontraded goods mentioned above. That is, they are included in both summations in (5) but with zero tariffs. These simplified effective rates are noticeably higher than the nominal rates, especially in the United States and the EEC, although in Japan several of the effective rates were negative. Further, the nontraded sectors all have negative effective rates.

In columns (3) and (6) of tables 10.1–10.3, we report the "change in per unit value added" (CPVA) for pre- and post-Tokyo Round based on our model, using equation (2) above. These calculations were obtained by reducing the tariffs from their given levels to zero and then using the negative of the resulting price changes in equation (2) to calculate the CPVAs by sector. The calculations in column (6) reflect as well the agricultural concessions and liberalization of government procurement. Since the results in columns (3) and (6) are based on a full model solution, they take into account all of the interactions both within and among all thirty-four countries in the model.

The most noticeable feature of these results, which was also noted in Deardorff and Stern (1983b), is that our model calculations of CPVA are an order of magnitude smaller than the nominal tariffs and the simple effective tariffs based on the Corden formula. Also, there are many more sectors with negative protection in our calculations. We discussed earlier several reasons why we expect smaller and more negative values for our measure of protection than have traditionally been calculated. The most important of these reasons, based on our model, appears to be the imperfect substitutability between domestic and foreign goods.[11]

Given the importance of imperfect substitutability, some further explanation of how it works may be useful. When tariffs are increased, they raise the prices of imports. If domestic goods were perfect substitutes for imports, their prices also would rise by the same amount. But if substitution is imperfect, an equal rise in domestic prices would leave demand unchanged while increasing supply. Equilibrium requires instead that domestic prices rise by less than import prices to stimulate both supply and demand by equal amounts. This smaller rise in domestic prices means that protection, as calculated from equation (2), is reduced from what it would be if substitution were perfect.

Note further that domestic prices are only part of what appears in the numerator of (2). Import prices also enter, but negatively, to the extent that imports are used as inputs. Thus, imperfect substitution reduces substantially the protective effect of tariffs on output prices, but does not reduce by nearly as much the antiprotective effect of tariffs on input prices. Together these two mechanisms can account for much of the reduction in measures of protection going from columns (2) to (3) and (5) to (6) in the tables.

A related phenomenon, not mentioned so far, is the effect of tariffs on exports. If domestic and foreign goods were perfect substitutes, then a given industry could not both export and import. But with imperfect substitution such two-way trade can and does take place. Now, producers for export enjoy no increase at all in their output price when tariffs are

Table 10.1 **Protection Measures in the United States (Percent levels and changes in protection. Numbers in parentheses are column ranks.)**

		Pre-Tokyo Round			Post-Tokyo Round			Change due to Tokyo Round		
	ISIC	Nominal Tariffs (1)	Effective Rate of Protection (Corden) (2)	CPVA (Change Per Unit Value Added) (3)	Nominal Tariffs (4)	Effective Rate of Protection (Corden) (5)	CPVA (Change Per Unit Value Added) (6)	Nominal Tariffs (7)	Effective Rate of Protection (Corden) (8)	CPVA (Change Per Unit Value Added) (9)
Traded goods:										
Agr., for., & fish.	(1)	2.20(18)	2.09(18)	−1.96(29)	1.80(17)	1.91(18)	−0.21(27)	−0.40(4)	−0.18(12)	1.74(1)
Food., bev., & tob.	(310)	6.30(10)	13.41(5)	−0.01(20)	4.70(7)	10.16(4)	−0.05(24)	−1.60(12)	−3.26(22)	−0.04(23)
Textiles	(321)	14.40(2)	28.33(2)	0.12(5)	9.20(2)	18.02(2)	0.16(3)	−5.20(22)	−10.31(29)	0.04(7)
Wearing apparel	(322)	27.80(1)	50.63(1)	0.14(4)	22.70(1)	43.30(1)	0.12(5)	−5.10(21)	−7.33(28)	−0.02(21)
Leather products	(323)	5.60(11)	5.62(14)	0.11(6)	4.20(9)	4.95(12)	0.30(1)	−1.40(10)	−0.67(16)	0.19(2)
Footwear	(324)	8.80(5)	13.14(6)	0.06(9)	8.80(3)	15.37(3)	0.07(7)	0.0 (1)	2.23(1)	0.01(13)
Wood products	(331)	3.60(16)	4.58(15)	0.10(7)	1.70(18)	1.72(19)	0.05(9)	−1.90(14)	−2.86(20)	−0.05(26)
Furniture & fixt.	(332)	8.10(6)	12.33(8)	0.02(14)	4.10(11)	5.52(11)	−0.01(22)	−4.00(19)	−6.81(26)	−0.04(22)
Paper & paper prod.	(341)	0.50(22)	−1.14(28)	−0.02(23)	0.20(22)	−0.86(28)	0.00(14)	−0.30(3)	0.27(4)	0.03(9)
Printing & publ.	(342)	1.10(21)	1.32(20)	−0.00(18)	0.70(21)	0.90(20)	0.00(15)	−0.40(5)	−0.43(14)	0.00(15)
Chemicals	(35A)	3.80(14)	5.76(13)	−0.24(26)	2.40(16)	3.66(15)	−0.12(26)	−1.40(11)	−2.11(18)	0.12(4)

Pet. & rel. prod.	(35B)	1.40(19)	4.27(16)	−0.02(22)	1.40(19)	4.69(13)	−0.00(20)	0.0 (2)	0.42(3)	0.02(11)
Rubber products	(355)	3.60(15)	2.37(17)	0.15(3)	2.50(14)	1.95(16)	0.15(4)	−1.10(9)	−0.42(13)	0.00(16)
Nonmet. min. prod.	(36A)	9.10(4)	15.93(4)	0.31(2)	5.30(5)	9.23(6)	0.18(2)	−3.80(18)	−6.70(25)	−0.13(28)
Glass & glass prod.	(362)	10.70(3)	16.87(3)	0.08(8)	6.20(4)	9.77(5)	0.03(11)	−4.50(20)	−7.10(27)	−0.04(24)
Iron & steel	(371)	4.70(13)	7.81(11)	0.04(12)	3.60(12)	6.18(9)	0.05(10)	−1.10(8)	−1.63(17)	0.01(14)
Nonferrous metals	(372)	1.20(20)	1.03(21)	0.03(13)	0.70(20)	0.50(21)	0.05(8)	−0.50(6)	−0.53(15)	0.02(10)
Metal products	(381)	7.50(8)	12.70(7)	−0.02(21)	4.80(6)	7.86(7)	−0.01(21)	−2.70(16)	−4.84(23)	0.01(12)
Nonelec. machinery	(382)	5.00(12)	6.25(12)	−0.16(25)	3.30(13)	4.06(14)	−0.08(25)	−1.70(13)	−2.20(19)	0.08(6)
Elec. machinery	(383)	6.60(9)	9.38(10)	−0.26(27)	4.40(8)	6.34(8)	−0.22(28)	−2.20(15)	−3.04(21)	0.03(8)
Transport equip.	(384)	3.30(17)	1.80(19)	−0.43(28)	2.50(15)	1.94(17)	−0.28(29)	−0.80(7)	0.14(8)	0.15(3)
Misc. manufact.	(38A)	7.80(7)	11.11(9)	0.34(1)	4.20(10)	5.79(10)	0.11(6)	−3.60(17)	−5.32(24)	−0.23(29)
Nontraded goods:										
Mining & Quarrying	(2)		−0.70(26)	−0.09(24)		−0.47(26)	0.02(12)		0.23(5)	0.10(5)
Elec., gas, & water	(4)		−0.20(23)	0.05(10)		−0.16(23)	0.01(13)		0.04(11)	−0.05(25)
Construction	(5)		−4.69(29)	−0.01(19)		−2.88(29)	−0.02(23)		1.81(2)	−0.01(17)
Wh. & ret. trade	(6)		−0.77(27)	0.02(15)		−0.55(27)	0.00(16)		0.21(6)	−0.02(20)
Transp., stor., & comm.	(7)		−0.52(25)	0.01(16)		−0.35(25)	−0.00(18)		0.17(7)	−0.02(19)
Fin., ins., & real est.	(8)		−0.14(22)	0.05(11)		−0.09(22)	−0.00(19)		0.05(10)	−0.05(27)
Com., soc., pers. serv.	(9)		−0.41(24)	0.01(17)		−0.28(24)	−0.00(17)		0.13(9)	−0.01(18)

Table 10.2 Protection Measures in the European Community (Percent levels and changes in protection. Numbers in parentheses are column ranks.)

		Pre-Tokyo Round			Post-Tokyo Round			Change due to Tokyo Round		
	ISIC	Nominal Tariffs (1)	Effective Rate of Protection (Corden) (2)	CPVA (Change Per Unit Value Added) (3)	Nominal Tariffs (4)	Effective Rate of Protection (Corden) (5)	CPVA (Change Per Unit Value Added) (6)	Nominal Tariffs (7)	Effective Rate of Protection (Corden) (8)	CPVA (Change Per Unit Value Added) (9)
Traded goods:										
Agr., for., & fish.	(1)	7.10(13)	6.18(17)	−0.44(18)	4.86(12)	4.10(17)	−0.53(22)	−2.24(14)	−2.08(14)	−0.09(23)
Food, bev., & tob.	(310)	12.44(2)	20.96(2)	−0.20(14)	10.06(3)	17.83(3)	−0.07(13)	−2.38(16)	−3.13(21)	0.13(8)
Textiles	(321)	9.78(8)	11.42(11)	−1.52(28)	7.17(8)	8.79(10)	−1.14(29)	−2.62(18)	−2.63(17)	0.38(3)
Wearing apparel	(322)	16.77(1)	23.49(1)	−0.50(19)	13.37(1)	19.26(2)	−0.41(19)	−3.40(21)	−4.23(26)	0.09(11)
Leather products	(323)	3.65(18)	1.35(21)	−0.70(22)	2.01(21)	−2.19(28)	−1.07(28)	−1.63(8)	−3.54(23)	−0.37(28)
Footwear	(324)	11.67(3)	17.90(4)	−0.74(23)	11.63(2)	20.08(1)	−0.64(24)	−0.04(2)	2.17(1)	0.10(10)
Wood products	(331)	3.31(19)	2.00(20)	0.38(3)	2.51(18)	1.68(20)	0.11(6)	−0.79(4)	−0.32(10)	−0.27(27)
Furniture & fixt.	(332)	8.50(9)	18.20(3)	−0.83(24)	5.60(9)	11.30(8)	−0.52(21)	−2.90(19)	−6.90(29)	0.31(5)
Paper & paper prod.	(341)	7.32(12)	11.13(12)	0.54(1)	5.37(11)	8.29(12)	0.11(7)	−1.95(10)	−2.85(20)	−0.43(29)
Printing & publ.	(342)	3.23(20)	−0.64(22)	0.07(11)	2.06(20)	−1.03(26)	0.09(10)	−1.17(5)	−0.39(11)	0.02(15)
Chemicals	(35A)	11.49(4)	17.00(5)	−0.88(25)	7.95(5)	11.71(6)	−0.67(25)	−3.55(22)	−5.29(27)	0.20(7)

Pet. & rel. prod.	(35B)	1.16(22)	3.11(19)	0.37(4)	1.16(22)	3.39(18)	0.11(8)	0.0 (1)	0.28(4)	−0.26(26)
Rubber products	(355)	5.28(16)	3.76(18)	−0.63(20)	3.54(17)	2.29(19)	−0.52(20)	−1.74(9)	−1.47(12)	0.10(9)
Nonmet. min. prod.	(36A)	5.19(17)	8.95(15)	0.03(12)	3.66(16)	6.52(15)	0.02(11)	−1.53(6)	−2.43(16)	−0.01(16)
Glass & glass prod.	(362)	9.89(7)	15.30(7)	−0.29(17)	7.70(7)	12.16(5)	−0.20(17)	−2.19(13)	−3.14(22)	0.09(12)
Iron & steel	(371)	6.21(15)	15.43(6)	−0.25(15)	4.67(14)	11.59(7)	−0.18(15)	−1.54(7)	−3.84(25)	0.08(13)
Nonferrous metals	(372)	2.56(21)	9.92(14)	0.07(10)	2.13(19)	8.29(11)	−0.04(12)	−0.43(3)	−1.63(13)	−0.11(24)
Metal products	(381)	7.88(10)	10.75(13)	−0.26(16)	5.46(10)	7.07(13)	−0.19(16)	−2.42(17)	−3.68(24)	0.07(14)
Nonelec. machinery	(382)	6.45(14)	7.35(16)	−0.88(26)	4.37(15)	4.71(16)	−0.57(23)	−2.07(12)	−2.64(18)	0.31(4)
Elec. machinery	(383)	9.92(6)	13.51(9)	−0.66(21)	7.89(6)	10.79(9)	−0.40(18)	−2.03(11)	−2.72(19)	0.26(6)
Transport equip.	(384)	10.23(5)	14.65(8)	−1.38(27)	7.95(4)	12.31(4)	−0.99(26)	−2.27(15)	−2.34(15)	0.39(2)
Misc. manufact.	(38A)	7.70(11)	12.13(10)	−1.88(29)	4.67(13)	6.55(14)	−1.02(27)	−3.03(20)	−5.58(28)	0.86(1)
Nontraded goods:										
Mining & quarrying	(2)		−0.72(24)	−0.10(13)		−0.51(22)	−0.14(14)		0.22(5)	−0.04(18)
Elec., gas, & water	(4)		−0.80(25)	0.20(7)		−0.61(23)	0.14(4)		0.19(9)	−0.05(21)
Construction	(5)		−4.10(29)	0.21(6)		−2.96(29)	0.17(3)		1.14(2)	−0.04(20)
Wh. & ret. trade	(6)		−1.76(28)	0.26(5)		−1.37(27)	0.20(2)		0.39(3)	−0.06(22)
Transp., stor., & comm.	(7)		−0.94(27)	0.12(9)		−0.74(25)	0.09(9)		0.20(7)	−0.03(17)
Fin., ins., & real est.	(8)		−0.66(23)	0.45(2)		−0.46(21)	0.34(1)		0.19(8)	−0.11(25)
Comm., soc., pers. serv.	(9)		−0.83(26)	0.18(8)		−0.61(24)	0.13(5)		0.21(6)	−0.04(19)

Table 10.3 **Protection Measures in Japan (Percent levels and changes in protection. Numbers in parentheses are column ranks.)**

		Pre-Tokyo Round			Post-Tokyo Round			Change due to Tokyo Round		
	ISIC	Nominal Tariffs (1)	Effective Rate of Protection (Corden) (2)	CPVA (Change Per Unit Value Added) (3)	Nominal Tariffs (4)	Effective Rate of Protection (Corden) (5)	CPVA (Change Per Unit Value Added) (6)	Nominal Tariffs (7)	Effective Rate of Protection (Corden) (8)	CPVA (Change Per Unit Value Added) (9)
Traded goods:										
Agr., for., & fish.	(1)	18.40(2)	21.17(4)	0.86(1)	18.40(2)	21.40(4)	0.77(1)	0.0 (1)	0.23(14)	−0.08(26)
Food, bev., & tob.	(310)	25.40(1)	49.80(2)	−0.18(20)	25.40(1)	50.31(1)	−0.14(20)	0.0 (2)	0.51(7)	0.03(10)
Textiles	(321)	3.30(14)	−3.55(24)	−0.37(24)	3.30(12)	−2.41(24)	−0.39(24)	0.0 (3)	1.14(2)	−0.02(18)
Wearing apparel	(322)	13.80(4)	41.62(3)	−0.13(18)	13.80(4)	42.20(3)	−0.09(16)	0.0 (4)	0.58(4)	0.04(9)
Leather products	(323)	3.00(15)	−15.56(28)	−0.05(16)	3.00(13)	−14.75(28)	−0.12(19)	0.0 (5)	0.81(3)	−0.07(24)
Footwear	(324)	16.40(3)	51.99(1)	0.06(4)	15.70(3)	50.02(2)	−0.02(13)	−0.70(14)	−1.98(21)	−0.08(27)
Wood products	(331)	0.30(21)	−30.94(29)	−0.32(22)	0.30(21)	−30.59(29)	−0.27(22)	0.0 (6)	0.35(11)	0.05(8)
Furniture & fixt.	(332)	7.80(6)	16.45(5)	0.03(8)	5.10(7)	10.26(5)	0.00(10)	−2.70(19)	−6.18(27)	−0.02(20)
Paper & paper prod.	(341)	2.10(17)	1.22(15)	−0.04(14)	2.10(16)	1.75(14)	−0.05(14)	0.0 (7)	0.53(6)	−0.00(14)
Printing & publ.	(342)	0.20(22)	−1.58(23)	−0.01(12)	0.10(22)	−1.51(23)	−0.01(12)	−0.10(9)	0.07(17)	0.01(11)
Chemicals	(35A)	6.20(10)	8.69(11)	−0.04(13)	4.80(8)	6.39(11)	−0.11(17)	−1.40(15)	−2.31(22)	−0.07(25)

Pet. & rel. prod.	(35B)	2.80(16)	5.21(13)	0.51(2)	2.20(15)	4.14(13)	0.17(2)	−0.60(13)	−1.08(20)	−0.34(29)
Rubber products	(355)	1.50(18)	−5.17(27)	−0.78(26)	1.10(18)	−4.99(27)	−0.60(25)	−0.40(11)	0.18(16)	0.18(3)
Nonmet. min. prod.	(36A)	0.60(20)	−0.92(19)	−0.16(19)	0.50(20)	−0.54(19)	−0.11(18)	−0.10(10)	0.38(10)	0.05(7)
Glass & glass prod.	(362)	7.50(7)	12.02(9)	−0.05(15)	5.10(6)	8.10(7)	−0.07(15)	−2.40(18)	−3.92(25)	−0.02(19)
Iron & steel	(371)	3.30(13)	4.77(14)	−0.48(25)	2.80(14)	4.34(12)	−0.65(27)	−0.50(12)	−0.43(19)	−0.17(28)
Nonferrous metals	(372)	1.10(19)	1.18(16)	−0.08(17)	1.10(19)	1.73(15)	0.09(4)	0.0 (8)	0.55(5)	0.17(4)
Metal products	(381)	6.90(9)	12.52(7)	−0.33(23)	5.20(5)	9.23(6)	−0.23(21)	−1.70(17)	−3.29(24)	0.10(6)
Nonelec. machinery	(382)	9.10(5)	15.57(6)	−0.23(21)	4.40(10)	6.74(9)	−0.27(23)	−4.70(22)	−8.83(29)	−0.04(22)
Elec. machinery	(383)	7.40(8)	12.49(8)	−1.10(28)	4.30(11)	6.73(10)	−0.86(28)	−3.10(20)	−5.76(26)	0.24(2)
Transport equip.	(384)	6.00(12)	8.42(12)	−1.73(29)	1.50(17)	0.03(16)	−1.58(29)	−4.50(21)	−8.39(28)	0.15(5)
Misc. manufact.	(38A)	6.00(11)	10.00(10)	−0.87(27)	4.60(9)	7.30(8)	−0.62(26)	−1.40(16)	−2.70(23)	0.25(1)
Nontraded goods:										
Mining & quarrying	(2)		−1.49(22)	0.06(5)		−0.99(22)	0.01(9)		0.50(9)	−0.05(23)
Elec., gas, & water	(4)		−1.11(21)	−0.00(11)		−0.79(21)	−0.00(11)		0.33(12)	−0.00(15)
Construction	(5)		−5.07(26)	0.06(6)		−3.64(25)	0.06(5)		1.43(1)	0.00(12)
Wh. & ret. trade	(6)		−0.59(18)	0.04(7)		−0.39(18)	0.03(6)		0.21(15)	−0.00(17)
Transp., stor., & comm.	(7)		−1.04(20)	0.02(10)		−0.54(20)	0.02(7)		0.50(8)	0.00(13)
Fin., ins., & real est.	(8)		−0.21(17)	0.16(3)		−0.16(17)	0.14(3)		0.05(18)	−0.03(21)
Com., soc., pers. serv.	(9)		−3.96(25)	0.02(9)		−3.69(26)	0.02(8)		0.27(13)	−0.00(16)

raised and, if anything, suffer a fall in price if world markets weaken. Thus, producers for export experience only antiprotective effects of tariffs. When they are averaged in with producers for domestic markets, as they are in the calculations we report, they account still further for the smallness of our measures of CPVA.

Regarding nontraded goods, we find that in most cases they are protected positively rather than negatively in a general equilibrium model.

Finally, in columns (7) to (9) of tables 10.1–10.3, we report the *changes* due to the Tokyo Round in nominal tariffs, simple effective tariffs based on equation (5), and our model calculations of CPVA based on equation (2). The calculations in column (9) are of most immediate interest since they provide an indication of which sectors will tend to expand or contract relatively in response to the tariff reductions and NTB concessions that were negotiated among the major industrialized countries.

Thus, in the United States, the largest percentage increases in value added due to the Tokyo Round were recorded in agriculture, leather products, transport equipment, chemicals, and mining and quarrying; while the largest percentage declines were in miscellaneous manufactures, nonmetallic minerals, finance, insurance, and real estate, wood products, and electricity, gas, and water. For the EEC, the largest percentage increases in value added due to the Tokyo Round were in miscellaneous manufactures, transport equipment, textiles, nonelectric machinery, and furniture and fixtures; and the largest declines were in paper and paper products, leather products, wood products, petroleum and related products, and finance, insurance, and real estate. For Japan, the largest increases were in miscellaneous manufactures, electrical machinery, rubber products, nonferrous metals, and transport equipment; and the largest declines were in petroleum and related products, iron and steel, footwear, agriculture, and chemicals.

To make comparisons involving the columns in these tables, we calculated both simple and rank correlations for each pair of columns in each table. Based on these correlations (which are not reported here but are available on request), it does not seem to matter very much whether one uses nominal tariffs or effective tariffs to measure protection. The two are highly correlated for each group of columns. On the other hand, our measure of CPVA is generally not significantly correlated with either of the other two measures of protection. Thus, one needs something like the approach based on our model to evaluate correctly the positions of individual sectors due to protection or changes therein. Otherwise, the effects of general equilibrium and imperfect substitution are not taken into account. Corden's simple formula does not even provide a poor approximation for this purpose.

The similarity of pre- and post-Tokyo Round structures of protection also is apparent from the correlations, regardless of how protection is measured. This can be seen by comparing columns (1) and (4), (2) and (5), and (3) and (6). Likewise, the change in protection due to the Tokyo Round is for the most part strongly negatively correlated with the levels of protection, again regardless of how both are measured. This is evident by comparing columns (1) and (4) with (7), (2) and (5) with (8), and (3) and (6) with (9). Thus, the effects of the Tokyo Round were in the direction of undoing the protection that previously existed, but were not strong enough to cause the overall pattern of protection to change significantly.

Besides calculating the effects of the Tokyo Round as just noted, we made several additional calculations of interest. These involved alternative measures of CPVA, correlation analysis designed to explain the nature of tariff reductions in the Tokyo Round, evaluation of indicators of resource pull, some further comparisons of the structures of protection in pre- and post-Tokyo Round, and the effects of the Tokyo Round on the developing countries. Let us consider each of these in turn.

10.4.1 Alternative Measures of CPVA

Our basic measure of the CPVA due to the Tokyo Round is calculated from our model assuming simultaneous changes in both tariffs and quantifiable NTBs in all (developed) countries at once. Also, our basic solution assumes a technology of fixed coefficients among intermediate inputs. To investigate the importance of these assumptions, we conducted alternative runs of the model in which we calculated CPVA for tariff changes only, for own-country tariff and NTB changes only, and for a version of the model with a Cobb-Douglas technology. The results were as follows.

For most developed countries, it made little difference whether the tariff and NTB changes for all countries were accounted for or only the own-country effects were calculated. This may be a surprise, since one might expect the effects of foreign tariff reductions to be quite different from one's own. The reason that this is not the case is that the patterns of tariff reduction were quite similar in most countries. This means that foreign tariff reductions do tend to offset the effects of domestic ones, but in the same industries, thus merely dampening their effects and not changing their pattern very much.[12] This pattern of correlated tariff reductions may bear out earlier observations of previous negotiations, namely, that trade liberalization has usually been balanced, presumably to avoid major industry dislocation.

Further, it does not seem to matter very much for the structure of protection whether negotiated changes in NTBs are or are not included in calculating the effects of the Tokyo Round. All correlations between the two sets of results are large and quite significant except for Norway and Sweden, where correlations are negative, and to a lesser extent Finland, Switzerland, and Mexico. These are all countries where NTB concessions were substantial, especially compared to country size.

Finally, the introduction of a Cobb-Douglas technology into the model in place of fixed coefficients made virtually no difference for the results, especially in the major industrialized countries.[13] Both simple and rank correlations were above 0.90 and highly significant for CPVA measures from the two runs, except in a few developing countries.

10.4.2 Explanations of the Pattern of Changes in Tariffs and Protection

We correlated both nominal tariff changes and CPVA with a number of variables that we thought might help to explain *why* tariffs were reduced as they were in the Tokyo Round. The ideas here stem from the recent interest in the political economy of protection. Ideally, policymakers and their constituents understand the economy well enough so that it is the actual *effects* of protection that guide their lobbying and policy choices. These effects are what we try to capture in our CPVA measure. However, if either our measure is inaccurate or, more likely, if policymakers are unable to perceive where true economic interest lies, then they may view nominal tariffs as the more appropriate indicator of protection, and it is this that will be correlated with the variables explaining protection.

One problem here is that the variables we look at are likely to influence both the level of protection and its change. Thus, for example, import penetration seems a likely source of protectionist pressure, and this could show up as small Tokyo Round tariff reductions and hence a large protective effect of the Tokyo Round. On the other hand, this same import penetration would also account for high pre-Tokyo Round tariffs and, if in general tariffs are reduced by some across-the-board proportion, it would also show up as large tariff reductions and a small or negative protective effect. Therefore, we do not know a priori whether a determinant of protection will show up in our results as a large or as a small protective effect due to the Tokyo Round. Our results are important in indicating the pattern of changes that are likely to have occurred, but they do not tell us anything about the validity or otherwise of various political theories of protection.

A final problem with the interpretation of these correlations concerns the mechanism of causation. The CPVA is calculated endogenously in our model and depends on everything in it. It is not at all an exogenous indicator of the results of the Tokyo Round negotiations. Thus it may be, as we have found before, that virtually *any* pattern of tariff reductions will tend to benefit traded sectors at the expense of nontraded ones, and thus give us a positive correlation between CPVA and import or export shares independently of whether the negotiations in fact favored sectors with large trade shares. Again, our results telling who has benefited are valid.

But whether this benefit was the deliberate outcome of the political process or instead a built-in economic effect of the way an economy responds to trade liberalization, we cannot say.

With these remarks as caveats, let us turn now to our findings. The patterns we report are based on correlations that were run between pairs of variables, both for individual countries and industries, across groups of countries and industries, and overall.

Initial Tariffs. As just explained, an across-the-board tariff reduction would reduce large tariffs the most, and a harmonization formula (e.g., the Swiss formula) should have this effect to an even greater extent. When we correlated nominal tariff changes with initial (pre-Tokyo Round) nominal tariff levels, this was confirmed. That is, the correlation between the two was negative and significant, although not terribly large. Thus, tariffs in the Tokyo Round were in fact reduced the most in those sectors where they were initially highest.[14] Interestingly, this relationship does *not* carry over to the estimated effects of the Tokyo Round as measured by the CPVA. Here the only significant correlations are positive, but these are few enough to be not particularly meaningful. Thus, it appears that initial tariffs are a poor guide to the protective effects that actually occurred as the general equilibrium implications of the Tokyo Round worked themselves out.

Initial Protection. When we correlated CPVA due to the Tokyo Round with the CPVA due to initial tariffs, we did find a strong relationship. The simple correlation is negative and significant (−0.61). Previously protected sectors appear therefore to be the greatest losers from the Tokyo Round. It may well be that this result is the automatic bias in favor of traded goods that we normally observe for trade liberalization. Presumably those sectors that were initially the most protected were also rather lightly involved with trade as a result.

Trade Shares. We correlated both tariff changes and CPVA due to the Tokyo Round with various import and export shares. Since trade shares are zero for nontraded sectors, and since tariff changes were zero for the developing countries, the only meaningful correlations here are those for the traded sectors of the developed countries. We looked first at each sector's share of its country's imports and exports. We found nothing significant for import shares, yet small but significant correlations with export shares. The latter were negative for tariff changes, but positive for CPVA. This indicates that tariffs tended to be reduced in most sectors with large export shares, but that these sectors were also the most likely to benefit from reductions overall. This suggests that it is not really the country's own tariff reductions that are providing the benefit here, but rather those of its trading partners. We have already seen how the tariff changes tend to be correlated across countries, so this makes some sense. The failure of the import shares to show a significant correlation is somewhat surprising, given our expectation of benefits from relying on trade. Indeed, when nontraded sectors are included, the correlation does become positive and significant, making it clear that traded sectors benefit more than nontraded ones, but within the traded sector group we find no such relationship.

Looking at countries' shares of *world* exports and imports by sector, similar results were found. No significant correlations appeared for import shares, but significant correlations were noted for export shares of world markets. Again though, they are small and of opposite sign for tariff changes and CPVA. These indicate that tariff reductions were largest where they were also presumably the least meaningful, that is, in those sectors and countries with the most dominant export positions in world markets. Furthermore, since the benefits of general trade liberalization go substantially to exporters, it is the dominant export sectors and countries that benefit the most.

Net Exports. We also looked for correlations with net export positions and found results that parallel those for exports above.

Final Demand Shares. In light of the observation that tariffs are highest on final goods and lowest on primary and semiprocessed goods, we might then expect some relationship between our results and the shares of final demand in total demand by industry. However, we did not find anything significant here either, except for a slight tendency for tariffs to be reduced most in sectors with large final demand shares. Thus, we find no evidence that protection has become any more or less cascaded against imports of final goods as the result of the Tokyo Round.

Labor Shares. To see whether the Tokyo Round favored labor-intensive industries, we correlated tariff changes and CPVA with shares of labor in both value added and gross output. Nothing meaningful was found.

Employment. As another check on the connection between protection and labor, we correlated our results with employment, both levels and shares. While nothing much significant was found, the results had one odd feature. Simple correlations were not significant, but in several instances rank correlations, though small, were. These rank correlations show some evidence, admittedly weak, that tariffs were reduced most in those sectors where both employment levels and shares were large, while at the same time the Tokyo Round had its most beneficial effects, measured by CPVA, in these same sectors.

NTBs. We correlated CPVA with our data on quantitative restrictions on trade and found nothing significant.

10.4.3 Indicators of Resource Pull Effects of Protection

Corden's formula in equation (5) for the effective rate of protection was intended to provide a better indicator of the effect of protection on resource allocation than was provided by nominal tariffs. Our measure of CPVA is intended to be even better. To check that the various measures do in fact perform this way, we correlated them with estimates calculated from the model of changes in employment, changes in outputs, and changes in the returns to capital by sector and country. The results of these correlations demonstrate clearly the superiority of our measure of CPVA over both nominal and effective tariffs in determining resource flows.[15]

Looking first at employment changes, in percentage terms, we found a strong positive relationship between these and our CPVA measure. The rank correlation across developed country traded sectors was 0.97 and was almost as high when developing countries and nontraded goods were included. Simple correlations were smaller, but still significant at the 99 percent level. Corden's effective tariff changes showed no significant correlation with employment changes in developed country traded sectors. Nominal tariff changes did even worse, since they showed a small but significant *negative* correlation with employment changes, even for developed country traded goods. The reason, again, is the similarity of tariff reductions among the developed countries, which leads employment to expand in precisely those sectors where tariffs are being reduced the most. Here, presumably, it is the fact that our measure of protection captures worldwide tariff changes that makes it work so well.

Output changes, again in percentage terms by sector and country, were similarly well explained by our CPVA measure and not at all by nominal and effective tariff changes. The only difference in comparison with the employment change results just noted is that nominal tariffs no longer showed any significant correlation of any sign.

Finally, we calculated the change in the return to capital by sector and country due to the Tokyo Round as an indicator of the incentives for long-run resource movement. This was calculated as the change in value added net of wages, as a percent of the (fixed) value of the capital stock. From this definition it may not be surprising that the CPVA will be related to it, since their definitions overlap. However, the relationship is not at all trivial, since changes in employment change the wage bill in a direction that could conceivably cancel out improvements in the return to capital. Nonetheless, our correlations showed the strongest connection yet between CPVA and changes in the return to capital, both simple and rank correlations being close to unity wherever we measured them. Once again, both nominal and effective tariffs failed to show any significant correlations with this variable worth noting.

We conclude therefore that our measure provides a vastly superior indicator of resource flows than the alternatives. Given that our basis for comparison is the pattern of resource flows calculated by our own model, the success of our measure may not be surprising. But the failure of even the Corden measure to correspond at all with these calculated flows is surprising indeed, since the Corden formula is intended to yield an approximation to the same economic magnitude of the change in per unit value added. Nonetheless, the Corden measure seems to provide no guidance at all, and nominal tariffs are actually misleading as to the pattern of resource flows as we have calculated them.

10.4.4 Further Comparison of the Pre- and Post-Tokyo Round Structure of Protection

We have already noted that changes in protection were negatively correlated with their levels prior to the Tokyo Round. This was also true for the structure of protection remaining after completion of the Tokyo Round. Both of these results are consistent with the view that the Tokyo Round tended to reduce tariffs across the board, without much effect on the cross-industry and cross-country pattern of protection. This was verified even more strongly when we correlated the structures of protection for the pre- and post-Tokyo Round with each other. Here both simple and rank correlations were in the 90 percent range throughout and highly significant.

It was also of interest to examine whether the efforts to "harmonize" the tariff reductions using the Swiss formula had the desired effect of making structures of protection more uniform. To check this we calculated coefficients of variation of our CPVA measures of pre- and post-Tokyo Round protection across industries, across countries, and overall. These turned out to have remained roughly the same before and after the Tokyo Round, suggesting that if levels of protection are indeed more uniform, it is only because they are closer to zero. This is in marked contrast, incidentally, to the pattern of nominal tariffs. The coefficients of variation for these fell consistently due to the Tokyo Round for all countries, almost all industries, and overall. Thus, while the general adherence to the Swiss formula resulted in some harmonization of nominal tariffs, this may not be particularly meaningful in terms of harmonizing levels of protection.[16]

10.4.5 The Terms of Trade of the Major Developing Countries

Our final concern was to investigate whether the structure of changes in tariffs and NTBs in the Tokyo Round was biased in favor of, or against, the major developing countries. As an indicator of this, we correlated the changes in world prices that our model ascribes to the Tokyo Round with various measures of trade performance of the developing countries. These measures were import shares, export shares, and trade balances. None of the results was significant, with some minor exceptions. This suggests that the effects of the Tokyo Round were *not* significantly biased either for or against the major developing countries as far as changes in world prices are concerned.[17]

10.5 Conclusion

In this paper we have analyzed the protective effects of the changes in tariffs and NTBs that were negotiated in the Tokyo Round, using the Michigan Model of World Production and Trade. Since prices are endogenous in the model, we are able to calculate the changes in value added by sector for all the major industrialized and developing countries that participated in the Tokyo Round negotiations. We take into account the direct effects of changes in both domestic and foreign tariffs and NTBs, as well as the direct effects of exchange rate changes that may result from trade liberalization.

Clearly a general equilibrium model like ours is needed to analyze how individual sectors may be affected by trade liberalization. It will not be very helpful in this regard to look at changes in nominal tariffs or even effective rates of protection calculated under simplified conditions. As our results show, calculations from the model of changes in value added by sector are very good indicators of the sectoral resource shifts that tend to take place within a general equilibrium model.

Among the many findings noted in the paper, the following are especially noteworthy:

1. As just mentioned, the change in per unit value added (CPVA) as calculated using our model, provided substantially different information about the structure of protection than is available from either nominal or effective tariffs. This information is also superior in that it is closely related to the flows of resources that changes in protection bring about, while other measures are not very useful in this respect.

2. The Tokyo Round reduced protection most in those sectors that were previously most protected. Nonetheless, the pattern of protection remains substantially unaltered from what it was before.

3. The greatest benefits of the Tokyo Round will tend to be felt in those sectors with the greatest export interests. This is true even though these are also the sectors in which nominal tariffs tended to be reduced the most, and this reflects the fact that the pattern of tariff reductions was quite similar across most countries.

4. We found no evidence that levels of protection have become more uniform as a result of the Tokyo Round. Nor did we find, within the constraints of our model and the level of aggregation of our data, any significant evidence that protection is becoming any more or less cascaded against imports of final goods, or that the Tokyo Round has been biased against the exports of the major developing countries.

Appendix *Equations of the Model*

Country System Equations

Supply functions for export (X) and home (H) markets:

(A1) $S_{ij}^{I} = S_{ij}^{I}(p_{ij}^{I}, p_{i1}^{H}, \ldots, p_{in'}^{H}, p_{i1}^{M}, \ldots, p_{in'}^{M}, \bar{w}_i, \bar{K}_{ij}^{I})$; $I = X, H$; $i = 1, \ldots, m$; $j = 1, \ldots, n$ or n'.

Demand functions for imported (M) and home-produced (H) goods;

(A2) $D_{ij}^{I} = D_{ij}^{I}(p_{ij}^{J}, [p_{ij}^{I}], E_i, S_{i1}^{H}, \ldots, S_{in'}^{H}, S_{i1}^{X}, \ldots, S_{in}^{X}, \bar{G}_{ij})$; I, $J = M, H$; $i = 1, \ldots, m$; $j = 1, \ldots, n$ or n'; [] if $j \leq n$.

Export and import prices:

(A3) $p_{ij}^{I} = [t_{ij}^{Meq}]R_i p_j^W$; $I = X, M$; $i = 1, \ldots, m$; $j = 1, \ldots, n$; [] if $I = M$.

Consumer expenditure and tariff revenue:

(A4) $E_i = \bar{E}_i^0 + \sum_{j=1}^{n} (t_{ij}^{Meq} - 1)R_i p_j^W D_{ij}^M$;
$i = 1, \ldots, m$.

Market equilibrium for home goods:

(A5) $S_{ij}^{H} = D_{ij}^{H}$;
$i = 1, \ldots, m$; $j = 1, \ldots, n'$.

Tariff equivalents (a: quotas; or b: import licensing):

(A6a) $t_{ij}^{Meq} = t_{ij}^{Meq}(\bar{t}_{ij}^M, D_{ij}^M, \bar{Q}_{ij}^M)$;
$i = 1, \ldots, m$; $j = 1, \ldots, n$.

(A6b) $D_{ij}^{M} = L_{ij}\left(\sum_{k=1}^{n} p_k^W S_{ik}^X + \bar{B}_i^K\right)$;
$i = 1, \ldots, m$; $j = 1, \ldots, n$.

Employment by industry:

(A7) $D_{ij}^{L} = D_{ij}^{L}([S_{ij}^{X}], S_{ij}^{H}, [\bar{K}_{ij}^{X}], \bar{K}_{ij}^{H})$;
$i = 1, \ldots, m$; $j = 1, \ldots, n$ or n'; [] if $j \leq n$.

Net exports:

(A8) $N_{ij}^{X} = S_{ij}^{X} - D_{ij}^{M}$;
$i = 1, \ldots, m$; $j = 1, \ldots, n$.

World System Equations

Market equilibrium for traded goods:

(A9) $\sum_{i=1}^{m} N_{ij}^{X} + N_j^{row}(p_1^W, \ldots, p_n^W, R_1, \ldots, R_m) = 0;$

$j = 1, \ldots, n.$

Trade balances:

(A10) $B_i^T = \sum_{j=1}^{n} p_j^W N_{ij}^X;$

$i = 1, \ldots, m.$

Exchange rates (a: fixed; or b: flexible):

(A11a) $R_i = \prod_{j \neq i} (R_j)^{\theta_{ij}^R} \bar{R}_{ij}^O \; i = 1, \ldots, m.$

(A11b) $B_i^T + \bar{B}_i^K = 0, \; (R_m = \bar{R}_m^O);$

$i = 1, \ldots, m-1.$

Notation (m = number of countries; n = number of tradable goods; n' = number of goods total)

Endogenous Variables:

S_{ij}^I = supply of good j by country i, sector $I = X, H$.

D_{ij}^I = demand for good j in country i from sector $I = M, H$.

$P_{[i]}^I$ = price of good j on world market ($I = W$) [or, in country i, price of export ($I = X$), import ($I = M$), or home sector ($I = H$)].

E_i = final expenditure in country i.

B_i^T = balance of trade of country i.

R_i = exchange rate of country i (price of world currency).

D_{ij}^L = demand for labor by industry j in country i.

t_{ij}^{Meq} = tariff equivalent on good j in country i.

$N_{[i]j}^I$ = net exports of good j by the rest of world (I = row) [or by country i ($I = X$)].

Exogenous Variables:

$\bar{K}_{ij}^I$ = capital stock of industry j, country i, sector $I = X, H$.

$\bar{w}_i$ = money wage in counry i.

$\bar{t}_{ij}^M$ = one plus tariff on good j in country i.

$\bar{G}_{ij}$ = government procurement parameter in industry j, country i.

$\bar{E}_i^O$ = exogenous component of expenditure in country i.
$\bar{R}_i^O$ = exogenous exchange rate of country i.
$\bar{B}_i^K$ = capital inflow into country i.
$\bar{Q}_{ij}^M$ = quota parameter for good j, country i.
θ_{ij}^R = pegged exchange rate weight.

Explanation of Functions and Regimes

(A1): Supplies, $S_{ij}^I(\cdot)$, depend on price of output, prices of all home and imported inputs, an exogenous country-wide wage, and exogenous capital stocks that are specific to the home and export sectors of each industry.

(A2): Demands, $D_{ij}^I(\cdot)$, depend on home and import prices, aggregate expenditure, outputs in all sectors (reflecting demands for inputs), and a shift parameter for government procurement.

(A6a): With quotas covering part of an industry, the tariff equivalent, $t_{ij}^{Meq}(\cdot)$, depends on the nominal tariff, other determinants of import demand, and a shift parameter representing the quota.

(A6b): With import licensing, tariff equivalents are determined implicitly to hold import demands at licensed levels. The licensing function, $L_{ij}(\cdot)$, allocates changes in net foreign exchange earnings, from exports and capital flows, to imports in proportion to their existing levels.

(A7): Employment equals labor demand, $D_{ij}^L(\cdot)$, and depends on output and sector-specific capital.

(A9): The rest of world contributes net supplies to world markets, $N_j^{row}(\cdot)$, that depend on world prices and exchange rates, the latter reflecting pegging by the rest of world to currencies in the model.

(A11a): Some currencies in the model are pegged, either to particular currencies or to baskets of currencies expressed as geometric weighted averages.

(A11b): Other currencies are flexible and determined so as to maintain zero balance of payments. One currency (the mth, usually the U.S. dollar) is numéraire and its value is exogenous.

Functional Forms

The behavioral functions in (A1), (A2), (A6), (A7), and (A9) are expressed as log-linear functions of the changes in the variables involved. They were derived from the first-order conditions for utility and profit maximation. The assumed utility and production functions were nested composites of the Cobb-Douglas, CES, and fixed-coefficient functional forms. Coefficients are calculated from data on production, trade, employment, and input-output transactions, plus published estimates of demand and substitution elasticities. Details are contained in Deardorff and Stern (1981).

Notes

1. In our early applications of the model, we examined proposed Tokyo Round tariff reductions in Deardorff, Stern, and Baum (1977) and the effects of exchange rate changes in Deardorff, Stern, and Greene (1979).

2. The industries are identified by names and International Standard Industrial Classification (ISIC) number in the accompanying tables. The model originally covered the eighteen major industrialized countries: Australia, Austria, Canada, the members of the European Economic Community, Finland, Japan, New Zealand, Norway, Sweden, Switzerland, and the United States. We have since added sixteen major developing countries: Argentina, Brazil, Chile, Colombia, Greece, Hong Kong, India, Israel, South Korea, Mexico, Portugal, Singapore, Spain, Taiwan, Turkey, and Yugoslavia.

3. This section is based in large measure on Deardorff and Stern (1983b).

4. The role of imperfect substitutability in trade modeling has been addressed also in de Melo and Robinson (1981).

5. Corden (1971) has gone well beyond the simple formula of equation (5) in considering many of the general equilibrium complications that our model is designed to incorporate. We will associate the simple formula with his name only for ease of reference.

6. It is also common to assume fixed production coefficients. Our model is capable of handling either fixed or variable coefficients, and, as will be noted below, we have done the calculations both ways.

7. We have explored the sectoral impact of exchange rate changes in several papers, beginning with Deardorff, Stern, and Greene (1979).

8. The bilateral agricultural concessions were modeled as a relaxation of import quotas in each of the countries. For government procurement, we had information on the amounts of nondefense procurement that governments had tentatively agreed to open to foreign bidding. We assumed these amounts would be spent in proportion to the sector breakdown of each government's expenditures. Estimated government imports by sector were then determined by applying import shares from the private sector. This procedure will tend somewhat to overestimate the effects of procurement liberalization since, due to data limitations, no allowance has been made for existing government imports.

9. To make the reporting of our results somewhat less burdensome, we decided to concentrate only on the United States, EEC, and Japan. For this purpose, the EEC member countries have been combined using weighted averages for the particular measures noted. It should be noted, however, that all of our calculations have been done using the full thirty-four-country model and that detailed results are available for each country.

10. In calculating these effective rates, we did not attempt to make any adjustments in the input-output coefficients to correct for any biases in using actual rather than free trade conditions.

11. In Deardorff and Stern (1983b), we examined the effects of country size, exchange rate flexibility, and foreign tariffs, all of which had relatively much smaller effects than imperfect substitutability.

12. It is noteworthy that this is not the case in Japan, where the correlation between own-country and all-country protection measures is not significant, and New Zealand, where the correlation is negative. In correlations run between pairs of developed country vectors of tariff reductions, these two countries stand out as unusual.

13. It should be noted that our model is not able currently to incorporate differences between the capital-to-intermediate good elasticity, on the one hand, and the labor-to-

intermediate good elasticity, on the other. Our experiment using Cobb-Douglas technology should thus be interpreted with this limitation in mind.

14. This finding was least true for Japan, where neither simple nor rank correlations, though negative, were significant. Since our data on tariff offers reflected the unilateral tariff reductions made by Japan prior to the conclusion of the Tokyo Round negotiations, our comparisons for Japan may not reflect accurately the forces involved there.

15. De Melo and Robinson showed that across-the-board tariff changes are likely to have different effects on resource allocation than tariffs changed individually by sector. Our results, which involve comparisons of across-the-board tariff changes for the individual measures noted, are in agreement with their conclusion but show it to be the case even more strongly.

16. With only twenty-two tradable industries in our model, it is certainly possible that harmonization did occur but is obscured by our level of aggregation. Since we did find evidence of harmonization of nominal tariffs, however, such harmonization of true protection must have been relatively weak.

17. As we point out in Deardorff and Stern (1983a), the Tokyo Round tariff reductions will be beneficial to some developing countries involved currently in the exports of manufactures. But since many existing NTBs affecting a variety of manufactured exports from developing countries were left intact (e.g., textiles and apparel, footwear, etc.), the Tokyo Round may be of limited consequence for these countries.

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