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Cooperation or Confrontation in U.S.–Japan Trade? Some General Equilibrium Estimates*

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Using a detailed calibrated general equilibrium model, we evaluate the effects of greater cooperation or confrontation in bilateral trade relations between the U.S. and Japan. Our numerical results indicate that, if a trade war between the two were precipitated, the U.S. would eventually benefit from the mutual imposition of reciprocally optimal tariffs. While this result appears negative for those who advocate free trade, it provides the key to overcoming an important incentive problem of liberalization. Specifically, we find that Japan gains more from U.S. unilateral liberalization than from bilateral liberalization and thus has an incentive to limit its commitment to removing trade barriers. Since the U.S. has a credible threat of retaliation, however, it can bargain with Japan to implement bilateral cooperation. In other words, the strategic environment is neither completely harmonious nor discordant. A credible threat of confrontation can secure the basis of cooperation. *J. Japan. Int. Econ.* June 1999, **13**(2), pp. 119–139. Research Institute for Economics and Business Administration, Kobe University, Kobe 657-8501, Japan; and Department of Economics, Mills College, Oakland, California 94613, and Centre for Economic Policy Research, London, United Kingdom. © 1999 Academic Press

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1. INTRODUCTION

Despite its status as one of the world's largest and most dynamic bilateral trade relationships, the benefits of existing U.S.–Japan trade have sometimes been questioned in policy and academic circles.[1] A variety of trade disputes over access to the Japanese market continue, while the threat of protectionist measures against Japan has become a bargaining tool for the United States.[2] In this paper, we assess the effects of more confrontational U.S.–Japan trade relations and contrast them with more cooperative trade policies. Using a detailed two-country calibrated general equilibrium (CGE) model, we present empirical simulation results on bilateral trade war and trade liberalization.[3]

Previous studies evaluating welfare effects of a trade war reveal possibilities for welfare deterioration to all countries and welfare gains to some nations at the expense of the others. In his theoretical investigation, Johnson (1954) suggests that under a certain set of conditions, one country could become better off in a tariff war than under free trade. With product differentiation and monopolistic competition, however, Gros (1987) shows that neither country is likely to gain in a tariff war. Using an applied partial equilibrium model of the motor vehicle industry, Gasiorek *et al.* (1989) show North America gaining from a tariff war with both the EC and Japan. Markusen and Wigle (1989) find that the United States is essentially indifferent between Nash equilibrium tariffs and free trade, while Canada is better off by 4 billion (1977) U.S. dollars under free trade. Using a seven-country CGE model, Perroni and Whalley (1994) show that the United States and the EC's welfare could increase by 52.5 and 128.4 billion (1986) U.S. dollars, respectively, under a global Nash tariff war. However, the other five regions (Canada, Mexico, Japan, other Western Europe, and the rest of the world) would incur U.S.$1.39 trillion in welfare losses, resulting in a world welfare loss of U.S.$1.21 trillion. These studies bear out Johnson's conclusion on the role of market power, generally showing a positive correlation between country size and the optimal tariff rates.

Although both liberalization and trade war have been studied in a general equilibrium framework by a number of authors, the results presented in this paper are

[1] See, e.g., Dornbusch (1990), Lawrence (1987), and Tyson (1993).

[2] Schoppa (1997) attempts to identify strategies for the use of American pressure that might lead to Japanese concessions in a variety of policy issues.

[3] Petri (1984), the first to construct a U.S.–Japan CGE model, shows that the effects of bilateral protection are highly asymmetric. For example, a 10-percentage-point increase in U.S. tariffs on Japanese imports would raise U.S. income by $2.5 billion (in 1980 prices) and reduce Japanese income by $4.5 billion, while a similar Japanese tariff would increase Japanese income by $1.0 billion and lower U.S. income by $1.1 billion.

the most detailed available for the U.S. and Japan.[4] While Markusen and Wigle (1989) and Perroni and Whalley (1994) compute an optimal aggregate or uniform tariff rate for each country/region they cover, our model computes a vector of optimal sector-specific tariff rates for the two countries that maximizes their domestic welfare. The next section provides a brief description of the two-country CGE model. Section 3 analyzes the welfare effects of a trade war where each country chooses sequentially an optimal set of bilateral tariff rates to maximize its equivalent variations. In Section 4, results of unilateral and bilateral trade liberalization experiments are assessed and compared with results of the trade war experiments. In Section 5, sensitivity analysis is conducted for both trade war and trade liberalization experiments to establish the robustness of our results. The final section summarizes our conclusions and discusses possible extensions of the present analysis.

2. A U.S.–JAPAN CALIBRATED GENERAL EQUILIBRIUM MODEL

Our two-country CGE model is an 18-sector economywide model which simulates price-directed resource allocation in commodity and factor markets.[5] It maintains detailed information on sectoral prices, output, trade, consumption, and factor use in a consistent framework that also accounts for national aggregates such as income, expenditures, and savings. We have calibrated the model with a complete 1985 U.S.–Japan social accounting matrix (SAM), including input–output accounts for the 18-sector aggregation.[6] The SAM not only itemizes economywide transactions between firms, households, government, and other domestic and foreign institutions, but provides import matrix by origin country.

Our model is distinguished by three important specifications.[7] First of all, in both countries, import and export demand and supply are fully endogenous. In other words, the U.S. and Japan are large enough to affect prices in the bilateral and the rest of the world (ROW) markets. The resulting six sets of sectoral trade flows are thus governed by six endogenous price systems (U.S.–Japan, U.S.–ROW, and Japan–ROW imports and exports).

A second feature of this model is its differentiated product specification of the demand and supply for tradeable commodities. The extent of price adjustments,

[4] For trade liberalization experiments, see, e.g., Francois and Shiells (1994), Goldin *et al.* (1993), Lee and Roland-Holst (1995), Lee *et al.* (1997), Martin and Winter (1996), Srinivasan and Whalley (1986), Yang *et al.* (1997), and Young and Chye (1997). For trade war experiments, see, e.g., Lee and Woodall (1998), Perroni and Whalley (1994), and Whalley (1998).

[5] The 18 sectors are classified as follows: (1) agriculture, forestry, and fisheries, (2) petroleum and mining, (3) food processing, (4) textiles, (5) wood products, (6) paper products, (7) chemicals, (8) nonmetallic mineral products, (9) steel, (10) nonferrous metals, (11) fabricated metal products, (12) general machinery, (13) electrical machinery, (14) motor vehicles, (15) other transport equipment, (16) precision instruments, (17) other manufactures, and (18) services.

[6] The U.S.–Japan SAM is available from the authors upon request.

[7] See Lee and Roland-Holst (1998) for a complete set of model equations.

as well as the volume and pattern of trade creation and trade diversion, are all important factors in determining the ultimate welfare effects of bilateral trade policy. In this model, domestic demand consists of goods that are differentiated by origin (domestic goods, imports from the bilateral partner, and imports from ROW) and domestic production is supplied to differentiated destinations (domestic market, exports to the bilateral partner, and exports to ROW). Extending similar assumptions in the CGE literature (e.g., de Melo and Tarr, 1992), the present model uses a nested constant elasticity of substitution (CES) specification for demand and a nested constant elasticity of transformation (CET) for supply. The values of various substitution elasticities used in the baseline case are presented in Table I.

Third, our CGE model is one of the few that treat international capital mobility endogenously. Since outward foreign direct investment (FDI) from Japan and inward FDI to the United States have increased dramatically in the past decade, we have made FDI, or sector-specific capital flows between the U.S., Japan, and the rest of the world endogenous. See Table II for the sectoral allocation of the stock of domestic capital and FDI. Capital is specified as a tradeable factor service whose demand is determined by domestic production functions and whose supply is determined by rental rate arbitrage conditions. We treat inward (nonresident) capital as a CES differentiated factor in domestic use and outward capital as a CET differentiated factor service export. Capital flows from the U.S. and Japan to each other and to ROW are fully endogenous, while we assume the two countries face perfectly elastic supply curves for inbound ROW capital.[8]

In the trade war and liberalization experiments conducted in Sections 3 and 4, assumptions of constant returns to scale and perfect competition govern firm behavior. While this specification of market structure and conduct is restrictive, it provides a clear baseline case for interpreting the adjustment process under different policy scenarios. In Section 5.2, three alternative models of scale economies and imperfect competition are employed and their results are compared to those obtained in the perfectly competitive model. Although it would not be difficult to project larger aggregate adjustments by specifying a process of intertemporal accumulation and investment, we have chosen comparative static analysis for the expedience and clarity of its results. The aggregate results are qualitatively consistent with larger gains and losses that would result from longer term implementation of the policies under study.[9]

3. TRADE WAR EXPERIMENTS

Given heightened tensions between the two economic superpowers in recent years, more confrontational U.S.–Japan trade policies are not an unrealistic

[8] This specification is discussed in greater detail in Lee and Roland-Holst (1998). The small country assumption for capital does not exert an important influence on our results.

[9] Baldwin (1992) shows that the extra output change resulting from human and physical capital accumulation is likely to be quite large, but the welfare impact of the dynamic gain from trade is relatively small.

TABLE I
Trade Elasticities Used in the Baseline Case

	σ	τ	μ	ξ	ω
		United States			
1 Agriculture	1.91	1.07	1.82	69.63	4.00
2 Petro and mining	0.65	0.91	0.58	16.20	43.65
3 Food proc.	1.55	0.73	1.49	66.30	66.90
4 Textiles	1.72	0.57	2.96	31.36	55.27
5 Wood	1.29	1.36	2.12	28.63	39.99
6 Paper	1.25	0.73	2.12	83.23	43.87
7 Chemicals	0.94	0.64	1.56	91.48	22.58
8 Nonmetallic mineral	1.16	0.43	0.96	50.00	8.60
9 Steel	1.77	0.48	2.30	20.00	20.00
10 Nonferrous metal	1.75	0.63	2.14	20.00	20.00
11 Metal products	1.53	0.61	1.39	79.12	6.66
12 General machinery	1.18	0.65	1.89	28.89	19.37
13 Electric machinery	1.52	0.58	1.70	8.45	9.56
14 Motor vehicles	2.12	1.03	2.84	5.00	10.00
15 Other transp. eq.	1.61	1.21	1.44	48.69	9.37
16 Precision inst.	1.76	0.54	1.77	50.00	6.14
17 Other manufac.	2.06	0.49	2.55	71.62	36.67
18 Services	1.30	1.00	1.90	100.00	100.00
		Japan			
1 Agriculture	1.65	1.07	1.28	55.38	100.00
2 Petro and mining	2.24	0.88	1.32	8.85	100.00
3 Food proc.	1.04	0.73	1.00	100.00	100.00
4 Textiles	1.45	0.55	1.27	60.51	24.56
5 Wood	2.26	1.33	1.53	21.70	39.73
6 Paper	1.93	0.80	1.31	100.00	100.00
7 Chemicals	1.55	0.66	1.13	97.76	62.15
8 Nonmetallic mineral	1.77	0.39	2.16	100.00	14.19
9 Steel	2.27	0.48	1.72	9.64	4.17
10 Nonferrous metal	2.76	0.63	1.72	15.75	80.74
11 Metal products	1.64	0.55	1.71	100.00	12.39
12 General machinery	1.47	0.64	1.07	83.51	15.36
13 Electric machinery	1.48	0.69	2.05	70.70	7.76
14 Motor vehicles	1.68	1.03	1.45	100.00	5.07
15 Other transp. eq.	1.87	0.98	1.43	40.56	11.75
16 Precision inst.	1.61	0.52	1.99	100.00	4.96
17 Other manufac.	1.54	0.57	1.10	91.82	39.13
18 Services	1.92	1.00	1.24	100.00	100.00

Sources. See Lee and Roland-Holst (1998).

Note. Definitions: σ = elasticities of substitution (EOS) between domestic and imported products; τ = elasticities of transformation (EOT) between domestic and exported products; μ = EOS between bilateral and ROW imported products; ξ = ROW import supply elasticities; ω = ROW export demand elasticities. The common EOT between bilateral and ROW exported products (υ) of 2.0 is assumed in both countries.

TABLE II
Sectoral Allocation of Stock of Domestic Capital and Foreign Direct Investment, 1985[a]

U.S. sectors	Stock of domestic capital	Stock of Japanese FDI in the U.S.	Stock of ROW's FDI in the U.S.
1 Agriculture	58,220.6	n.a.	n.a.
2 Petro and mining	34,227.5	27.2	12,024.7
3 Food proc.	19,927.9	118.9	3,931.7
4 Textiles	8,031.9	33.5	209.3
5 Wood	6,834.9	22.3	130.0
6 Paper	9,619.5	21.4	120.1
7 Chemicals	36,504.2	199.8	6,889.9
8 Nonmetallic mineral	4,477.9	36.2	273.1
9 Steel	1,243.4	16.1	48.7
10 Nonferrous metal	2,629.2	35.3	89.0
11 Metal products	11,669.8	58.3	441.3
12 General machinery	15,061.0	251.3	1,474.0
13 Electric machinery	13,177.5	210.9	1,038.5
14 Motor vehicles	5,721.7	109.8	485.3
15 Other transp. eq.	29,588.6	135.1	1,049.1
16 Precision inst.	7,198.2	25.9	429.1
17 Other manufac.	38,843.3	107.2	815.2
18 Services	888,780.3	6,525.0	34,591.6

Japanese sectors	Stock of domestic capital	Stock of U.S. FDI in Japan	Stock of ROW's FDI in Japan
1 Agriculture	76,638.0	n.a.	n.a.
2 Petro and mining	3,807.1	247.8	399.0
3 Food proc.	20,106.7	30.5	50.2
4 Textiles	8,125.9	20.8	34.5
5 Wood	6,334.5	17.9	28.5
6 Paper	7,356.4	21.5	35.3
7 Chemicals	19,690.4	311.8	510.8
8 Nonmetallic mineral	10,598.9	7.4	11.6
9 Steel	24,138.1	12.0	19.1
10 Nonferrous metal	4,063.0	7.3	12.1
11 Metal products	11,215.6	14.6	24.5
12 General machinery	14,819.9	320.4	523.2
13 Electric machinery	17,631.7	76.1	125.2
14 Motor vehicles	17,355.9	86.5	142.0
15 Other transp. eq.	3,408.3	61.2	30.3
16 Precision inst.	3,645.3	9.2	14.9
17 Other manufac.	15,429.2	32.5	53.8
18 Services	240,876.9	581.7	961.5

Sources. (1) United States: Department of Commerce, Office of Business Analysis database; Department of Commerce, *Survey of Current Business*. (2) Japan: Economic Planning Agency, *Gross Capital Stock of Private Enterprises*, 1965–1990; Ministry of Finance, *Zaisei Kinyu Tokei Geppo [Fiscal and Monetary Statistics Monthly]*.

[a] Millions of 1985 U.S. dollars.

policy scenario. Although negotiators generally understand the aggregate benefits of market-based international resource allocation and the efficiency costs of conflict, the political economy of trade is often even more arcane than neoclassical economics. It would thus be useful to do some reconnaissance in the uncharted terrain of U.S.–Japan trade wars. This section gives preliminary estimates of the magnitude and composition of costs that would be attendant upon a breakdown of this long and prosperous friendship.

We compute the welfare effects of tariff wars using the CGE model adapted to an optimization framework. Consumer demand is represented by a linear expenditure system (LES) of the form

$$C_i = \alpha_i + \left(\frac{\beta_i}{p_i}\right)(Y - \alpha), \tag{1}$$

where α_i are subsistence minimum consumption levels, β_i are budget shares for consumption ($\sum_i \beta_i = 1$), p_i are composite good prices, Y is disposable income, and $\alpha = \sum_i \alpha_i p_i$.[10] The indirect utility function corresponding to demand function (1) is given by

$$\mathrm{IU} = \prod_i \left[\left(\frac{\beta_i}{p_i}\right)(Y - \alpha)\right]^{\beta_i}. \tag{2}$$

Equivalent variation (EV), a broadly used measure of domestic welfare, is the difference between the minimum income level necessary to attain utility level $\mathrm{IU}(p^0, Y^0)$ given p^0 and that necessary to reach utility level $\mathrm{IU}(p^1, Y^1)$ given p^0. It can be expressed as[11]

$$\mathrm{EV} = (Y^1 - \alpha^1)\left[\prod_i \left(\frac{p_i^0}{p_i^1}\right)^{\beta_i}\right] - (Y^0 - \alpha^0). \tag{3}$$

In our general equilibrium simulations, a country (say, country A) initiates a tariff war by choosing a vector of bilateral tariff rates to maximize its EV assuming that the other country (country B) holds tariffs constant.[12] Country B then retaliates by choosing a vector of own bilateral tariffs to maximize its own EV, subject to the tariff rates of country A. The two countries maximize their welfare functions sequentially until a noncooperative (Nash) equilibrium is attained. With the present

[10] This demand function is derived from maximization of the Stone-Geary utility function

$$U = \prod_i (C_i - \alpha_i)^{\beta_i}$$

subject to the budget constraint.

[11] See de Melo and Tarr (1992) for derivation.

[12] We assume that protection against the rest of the world remains constant.

model, convergence is attained with six iterations, and the outcome is the same regardless of which country initiates conflict. This yields two sets of six simulations with the same final result.

We experimented with other aggregate welfare functions, including real GDP and nominal value added, but the results were qualitatively similar.[13] It should be emphasized that these results reflect a representative consumer approach to welfare. More disaggregated objective functions, perhaps more characteristic of the actual forces governing trade policy formulation, would not be as neutral in their effects.

Table III reports the economywide results of trade war simulation experiments.[14] In the first iteration, the terms-of-trade always improve for the country initiating trade hostilities (step 1, rows 3–4). In equilibrium, U.S. terms-of-trade improve against Japan because of its relative size. The strong terms-of-trade effects lead to relatively high optimal tariff rates: averaging 50.0% for the U.S. and 39.5% for Japan (Table IV).[15] The higher U.S. optimal tariffs lead to a real appreciation of the U.S. dollar against the yen (step 6, row 5). A major consequence of trade war for both countries is a reduction of about 25% in bilateral trade flows (rows 8 and 10).[16]

Although this is not reported in the table, it is worth noting that capital moves from Japan to the United States in every sector, driven by increases in real rates of return in U.S. industries. Capital moves from the United States to Japan when Japan initiates a trade war, but its flows are reversed when the U.S. retaliates. To the extent that the country with higher tariff protection attracts foreign direct investment, trade and FDI exhibit a substitutability relationship under tariff war. This result contrasts with our earlier finding (Lee and Roland-Holst, 1998) that under trade liberalization bilateral commodity and capital flows exhibit complementarity in many manufacturing sectors.[17]

[13] The average equilibrium tariffs were lower under EV maximization because the purchasing power component in the objective function mandated lower final goods prices.

[14] Sectoral results are available from the authors upon request.

[15] These tariff rates are higher than Markusen and Wigle's (1989) results, but substantially lower than Perroni and Whalley's (1994). Markusen and Wigle find Nash equilibrium tariff rates of 18.1% for the United States and 5.8% for Canada. The relatively low rates may be attributable to their optimization method, which repeatedly computes general equilibrium solutions over a grid of changes in U.S. and Canadian protection levels. In contrast, Perroni and Whalley find extremely high tariff rates—e.g., 400–500% for the U.S., about 220% for Japan, and 900–1000% for the EC. The authors acknowledge that these high post-retaliation tariff rates result largely from the low elasticity values they chose based on literature estimates and that increasing all trade elasticities by 33% would reduce EC's optimal tariffs from nearly 1000% to about 150%.

[16] The large country assumption implies that a reduction in bilateral import demand resulting from higher tariff rates will reduce world demand for imports from the bilateral partner, thereby reducing the world price of bilateral imports. (With the national product differentiation assumption, the world price of bilateral imports falls substantially.) Thus, for each sector, the domestic price of imports increases by significantly less than the optimal tariff rate, resulting in a reduction in bilateral trade that is proportionally smaller than an increase in the tariff rate.

[17] Under a different sectoral disaggregation, Lee and Roland-Holst (1998) find that bilateral liberalization between the United States and Japan without restrictions on FDI increases sector-specific bilateral capital flows in both directions in all U.S. and Japanese manufacturing sectors except aircraft.

TABLE III
U.S.–Japan Trade War Experiments

	U.S. leads		Japan leads	
	U.S.	Japan	U.S.	Japan
	Step 1			
1 Welfare[a]	4.50	−9.91	−3.01	2.03
2 Real GDP	0.22	−0.66	−0.09	0.14
3 Aggregate TOT[b]	1.81	−3.25	−1.95	4.55
4 Bilateral TOT[b]	14.63	−12.66	−14.92	17.98
5 Bilateral exchange rate[c]	−5.45	5.77	2.09	−2.05
6 ROW exchange rate[c]	−1.16	4.54	0.23	−1.82
7 Total imports	−1.66	−3.99	−0.40	−1.97
8 Bilateral imports	−21.73	−3.74	−1.44	−22.82
9 Total exports	−0.69	−2.67	−0.74	−1.52
10 Bilateral exports	−3.74	−21.73	−22.82	−1.44
11 Import adj. index	5.57	0.06	0.28	5.48
12 Export adj. index	0.39	11.85	2.71	0.05
	Step 2			
1 Welfare	1.61	−8.18	1.63	−9.95
2 Real GDP	0.13	−0.53	0.16	−0.66
3 Aggregate TOT	−0.25	0.42	0.07	−0.29
4 Bilateral TOT	−1.11	1.85	1.51	−0.94
5 Bilateral exchange rate	−3.66	3.80	−4.44	4.65
6 ROW exchange rate	−0.95	2.81	−1.13	3.47
7 Total imports	−2.00	−5.77	−2.39	−6.57
8 Bilateral imports	−22.72	−24.52	−26.79	−26.24
9 Total exports	−1.35	−3.99	−1.49	−4.55
10 Bilateral exports	−24.52	−22.72	−26.24	−26.79
11 Import adj. index	5.77	5.08	6.87	5.39
12 Export adj. index	2.86	11.81	3.06	14.02
	Step 6 (Equilibrium)			
1 Welfare	1.81	−9.95	1.81	−9.95
2 Real GDP	0.16	−0.66	0.16	−0.66
3 Aggregate TOT	0.08	−0.30	0.08	−0.30
4 Bilateral TOT	1.52	−0.95	1.52	−0.95
5 Bilateral exchange rate	−4.57	4.79	−4.57	4.79
6 ROW exchange rate	−1.15	3.59	−1.15	3.59
7 Total imports	−2.37	−6.40	−2.37	−6.40
8 Bilateral imports	−26.74	−24.79	−26.74	−24.79
9 Total exports	−1.45	−4.46	−1.45	−4.46
10 Bilateral exports	−24.79	−26.74	−24.79	−26.74
11 Import adj. index	6.86	5.01	6.86	5.01
12 Export adj. index	2.89	14.03	2.89	14.03

[a] Welfare effects are reported as Hicksian equivalent variations (EVs) in billions of 1985 U.S. dollars. All other figures are percentage changes.

[b] Terms-of-trade (TOT) effects are trade-weighted averages of percentage changes in commodity terms of trade.

[c] Bilateral and ROW real exchange rates are quoted as domestic/foreign currency, so a positive change implies real depreciation.

TABLE IV
Optimal Bilateral Tariffs in Trade War Experiments[a] (Percentages)

	tm^0	tm^1	tm^*
	U.S. tariffs		
1 Agriculture	0.2	55.3	42.0
2 Petro and mining	1.0	48.6	64.1
3 Food proc.	6.0	44.1	49.0
4 Textiles	18.1	46.6	54.5
5 Wood	3.4	54.3	59.9
6 Paper	4.4	54.7	62.0
7 Chemicals	8.0	35.6	42.6
8 Nonmetallic mineral	10.1	44.7	53.4
9 Steel	5.2	56.5	67.6
10 Nonferrous metal	3.7	49.7	59.1
11 Metal products	4.6	56.0	65.5
12 General machinery	3.9	48.2	58.6
13 Electric machinery	5.5	36.0	46.3
14 Motor vehicles	7.0	40.4	47.9
15 Other transp. eq.	3.9	19.0	28.0
16 Precision inst.	6.8	47.3	58.0
17 Other manufac.	7.1	45.2	50.7
18 Services	0.0	37.0	46.9
Trade-weighted avg.	5.1	40.9	50.0
	Japanese tariffs		
1 Agriculture	4.8	0.0	0.0
2 Petro and mining	1.8	57.8	56.9
3 Food proc.	16.0	54.1	48.4
4 Textiles	6.2	61.8	55.4
5 Wood	1.5	23.3	17.7
6 Paper	2.7	53.9	47.4
7 Chemicals	3.3	66.1	59.3
8 Nonmetallic mineral	2.7	48.4	44.3
9 Steel	1.9	36.8	30.0
10 Nonferrous metal	2.3	83.5	76.1
11 Metal products	3.5	54.3	49.0
12 General machinery	2.8	73.6	66.1
13 Electric machinery	2.9	62.7	57.6
14 Motor vehicles	13.2	52.8	47.0
15 Other transp. eq.	0.1	68.4	62.1
16 Precision inst.	5.7	62.1	57.1
17 Other manufac.	4.6	15.3	9.8
18 Services	0.0	64.0	59.7
Trade-weighted avg.	3.5	42.9	39.5

[a] Definitions: tm^0 = base tariff rates on bilateral imports; tm^1 = a bilateral country's optimal tariff rates given the other country keeps tm^0; tm^* = equilibrium optimal tariff rates.

Import and export adjustment indices are presented in rows 11 and 12. They are defined as the normalized changes in the composition of trade between the bilateral partner and ROW. For example, the import adjustment index is given by

$$\delta(M_0, M_1) = 100 \frac{\| M_1 |M_0| / |M_1| - M_0 \|}{\| M_0 \|}, \tag{4}$$

where $M_0 = (M_0^b, M_0^r)$ and $M_1 = (M_1^b, M_1^r)$ are the 2-tuple of bilateral and ROW imports in the base and after the experiment, respectively, and $\| \cdot \|$ and $| \cdot |$ denote Euclidean and simplex norms.[18] Not surprisingly, the extent of trade adjustment resulting from a trade war is quite large. In particular, a substantial portion of Japanese exports are diverted from the United States to the rest of the world.

Although the outcome is the same regardless of which country initiates trade hostilities, the strategic paths do depend on the sequence. If the U.S. initiates, it can impose aggregate costs on Japan which the latter cannot completely reverse by retaliation. If Japan strikes first, however, the U.S. retaliation will reverse the situation, imposing costs on Japan in the second step which attain the full magnitude of Japan's equilibrium losses. Generally, Japan is in a disadvantaged strategic position, since it can gain only during the first round when it initiates trade hostilities. After this, or in the event the U.S. strikes first, Japan inevitably loses. Japan's strategic position is even weaker, since the stable equilibrium is actually achieved at step 1 under U.S. leadership. Here the U.S. strikes first, but Japan would be unlikely to retaliate since it cannot impose sustainable losses on its adversary and would end up with lower welfare in equilibrium (–$9.95 billion instead of –$9.91 billion in EV).

This outcome might imply that the U.S. has an incentive to initiate or at least threaten protectionist action against its long-time trading partner, but several caveats are in order. First, we have assumed that the rest of the world would remain a passive spectator in open conflict between the world's two largest economies. Second, the national product differentiation convention leads to more market power for each country than may be empirically valid (Brown, 1987), implying higher optimal tariffs than would be obtained under a more flexible demand structure.[19] Third, we have assumed that the U.S. could implement an optimal set of tariffs, regardless of the sectoral reallocations these might occasion within its own economy. Because the optimal tariffs are relatively high, implementing them would entail considerable structural adjustment to accommodate the sharp contraction in bilateral exports and imports.

Another qualification of the results depends upon the assumption that both countries are fully employing their domestic endowments of labor and capital.

[18] The export adjustment index is defined analogously.

[19] Brown (1987) shows that in Armington-type models optimal tariff is nonzero even for a small country, suggesting that these models prejudice the case in favor of maintaining existing protection. The almost ideal demand structure (AIDS) is much more flexible than the CES demand structure, but it requires a great deal more information on parameter values (Deaton and Muellbauer, 1980).

If this were not the case, then optimal tariffs would be zero until the economy in question reached its production possibility frontier. In other words, in a neoclassical model, free trade is optimal for moving the economy from under utilization to full utilization. Only then is it reasonable to look from efficiency gains to the possibility of shifting factor rents and terms-of-trade effects. It is thus an open question whether the U.S. is in a position to realize the potential gains of exploiting its bilateral market power.

As reported in Table IV, equilibrium optimal tariff rates differ across sectors, particularly for Japan. They depend on CES demand and CET supply elasticities and trade shares, but it would be extremely difficult to derive a formula for sectoral optimal tariffs in a multisectoral general equilibrium framework. Interestingly, Japan's optimal tariffs on agriculture, the sector with the highest overall trade barriers, are zero. This suggests that an improvement in the agricultural terms of trade resulting from an increase in the tariff rate would have been small relative to the loss to consumers. Thus, Japan's welfare level could be significantly enhanced by the removal of agricultural trade barriers and, ironically, Japan's existing agricultural protection is not in the country's interest even in an adversarial trade situation. Optimal tariffs are relatively low for wood and steel products, where Japanese import demand is inelastic. The lowest among nonagricultural sectors is for other manufacturing, which has a relatively high U.S. supply elasticity and is a broadly used Japanese intermediate. U.S. average optimal tariffs are substantially higher and more uniform than Japan's largely because its size as an importer confers greater market power.

4. TRADE LIBERALIZATION EXPERIMENTS

The previous section's results that the U.S. welfare increases from the mutual imposition of optimal tariffs heighten the importance of understanding the potential gains from more liberal trade relations. In particular, whether the U.S. gains more from liberalization than from a tariff war is a central concern for policymakers. Table V summarizes the aggregate results of three types of liberalization, each entailing the removal of 1985 import protection (tariff and nontariff barriers) by one or both countries.[20] In experiment 1, the United States unilaterally removes import barriers on Japanese products. Experiment 2 represents Japanese unilateral liberalization toward U.S. products. In experiment 3, the U.S. and Japan both remove their bilateral import barriers.

In the first two experiments, the real exchange rate of the liberalizing country depreciates. This drives a large part of the adjustment process for the liberalizing economy, lowering the price of exports abroad and making domestic goods more competitive at home. The former effect improves the country's international competitive position, while the net effect of the latter depends on the extent of

[20] Again, sectoral results are available from the authors upon request.

TABLE V
Aggregate Results of U.S. and Japanese Trade Liberalization[a]
(Percentage Changes unless Indicated Otherwise)

	Experiment 1		Experiment 2		Experiment 3	
	U.S.	Japan	U.S.	Japan	U.S.	Japan
1 Welfare[b]	8.69	4.15	7.64	−1.40	15.98	2.54
2 Real GDP	0.17	0.25	0.21	−0.04	0.37	0.21
3 Aggregate TOT	−0.40	0.90	0.56	−1.06	0.14	−0.21
4 Bilateral TOT	−3.37	3.58	4.61	−4.00	1.09	−0.59
5 Bilateral exchange rate	3.03	−2.94	−2.39	2.45	0.53	−0.53
6 ROW exchange rate	0.66	−2.29	−0.32	2.11	0.33	−0.20
7 Total imports	0.66	2.18	0.65	1.25	1.33	3.43
8 Bilateral imports	8.96	2.19	1.84	20.70	11.08	23.30
9 Total exports	0.68	1.57	1.81	2.09	2.53	3.75
10 Bilateral exports	2.19	8.96	20.70	1.84	23.30	11.08
11 Import adj. index	2.16	0.00	0.31	4.27	2.52	4.28
12 Export adj. index	0.19	4.62	2.52	0.15	2.75	4.49
13 Aggregate inward FDI	−3.80	13.29	4.09	−8.03	0.20	3.88
14 Bilateral inward FDI	−6.63	8.52	5.46	−5.79	−1.43	2.06

[a] Definition of experiments: (1) U.S. unilateral liberalization on Japanese imports, (2) Japanese unilateral liberalization on U.S. imports, (3) U.S.–Japan bilateral liberalization.
[b] See Table III.

prior protection, import shares, and CES trade substitution elasticities. In the case of U.S. unilateral liberalization, these benefits outweigh negative terms-of-trade effects, and the liberalizing country gains overall. When Japan liberalizes unilaterally, however, the negative terms-of-trade effects outweigh positive income effects generated by liberalization, causing a welfare loss of $1.4 billion. The real depreciation of the home currency also causes a lower real rate of return on domestic investment, inducing net FDI outflows from the liberalizing country. This result may in part explain the persistence of Japanese trade barriers in agriculture and some other sectors.

Results of experiment 3 provide a partial answer to the question, how much of the potential for trade cooperation between the two countries is yet unrealized? As comparative statics results, these estimates provide a lower bound on the ultimate effects of bilateral liberalization.[21] What they indicate is that, although most of the fruits of cooperative trade might be realized with growth under the present trading regime, more liberal relations would confer even greater benefits. Given other existing conditions, bilateral trade liberalization would realize an increase

[21] An endemic attribute of comparative static, neoclassical models such as the present one is resource constraints and a consequent emphasis on patterns of adjustment and distribution rather than aggregate growth. Readers might be puzzled when they see relatively small aggregate effects resulting from dramatic policy changes like bilateral trade liberalization. This is an inevitable consequence of the type of model used for this analysis, which is designed to give detailed information on relative prices, the sectoral composition of supply and demand, and other reallocative effects in the economy.

of $15.98 billion in equivalent variation income for the United States and $2.54 billion for Japan. Bilateral imports for the two countries would increase by 11.1% and 23.2%, respectively.

The most important fact is that U.S. gains from bilateral liberalization are almost nine times those it could realize from "winning" a trade war, i.e., a successful implementation of optimal bilateral tariffs ($15.98 billion versus $1.81 billion). Note, however, that the bilateral liberalization is not incentive compatible as a purely cooperative outcome. The U.S. benefits more from unilateral liberalization, irrespective of Japan's response, than it could from a trade war. However, Japan has no independent incentive to reciprocate U.S. unilateral liberalization. As experiments 1 and 3 indicate (Table V), Japan is better off letting the U.S. liberalize alone. The solution to this incentive problem lies in the threat of noncooperative action. The trade war experiments suggest that the U.S. has a credible threat as a trade adversary, and this provides the mechanism to enforce bilateral liberalization.

5. SENSITIVITY ANALYSIS

5.1. *Foreign Direct Investment, Country Size, Input–Output Coefficients, and Trade Substitution Elasticities*

In this section, four sets of sensitivity tests for the trade war experiments are conducted. First, the model is recalibrated assuming no foreign direct investment flows. Second, U.S. intermediate demand, final demand, and value added are rescaled, so that the real GDP of the United States and Japan become roughly equal. Third, we remove the asymmetry in intermediate input matrices between the two countries by imposing the restriction that the input–output coefficients in Japan are equal to those of the United States.[22] Finally, we double the values of CES and CET trade substitution elasticities.

Table VI summarizes the results of trade war experiments under alternative assumptions and compares them with the baseline case. In the absence of FDI, the U.S. gains and Japanese losses become smaller than when FDI is allowed (columns 3–4 of Table VI). This is because capital moves from Japan to the United States in the latter case (Section 3). Because a reduction in Japanese capital stock and an increase in U.S. capital stock would amplify the impact on real output, the effects become smaller when there is no capital mobility.

While substantially lowering U.S. market power, rescaling the U.S. data to equalize the real GDP of the United States and Japan would not change the stronger strategic position held by the former (columns 5–6).[23] This outcome may be

[22] The new SAMs become unbalanced after these restrictions are imposed in the second and third cases. Income and expenditures of the household, government, and rest-of-world accounts are first modified to correct a significant portion of the inconsistencies, and a RAS (row-and-column sum) procedure is used to correct the remaining inconsistencies.

[23] Lee and Woodall (1998) obtain the result that both the U.S. and a group of East Asian countries lose from a U.S.–East Asian trade war.

TABLE VI
Sensitivity Analysis of U.S.–Japan Trade War Experiment (Percentage Changes unless Indicated Otherwise)

		Base trade war experiment		No FDI		Equal real GDP		Equal real GDP and I-O coeff.		Doubling subst. elasticities	
		U.S. (1)	Japan (2)	U.S. (3)	Japan (4)	U.S. (5)	Japan (6)	U.S. (7)	Japan (8)	U.S. (9)	Japan (10)
1	Welfare[a]	1.81	−9.95	1.47	−9.01	0.31	−2.21	0.52	−2.43	1.48	−6.55
2	Real GDP	0.16	−0.66	0.12	−0.54	0.00	−0.12	0.01	−0.13	0.13	−0.39
3	Aggregate TOT	0.08	−0.30	0.19	−0.53	0.16	−0.33	0.19	−0.40	0.02	−0.29
4	Bilateral TOT	1.52	−0.95	2.37	−1.82	3.96	−3.04	4.77	−3.70	1.39	−0.76
5	Bilateral exchange rate	−4.57	4.79	−4.85	5.10	−1.37	1.39	−1.53	1.56	−2.69	2.76
6	ROW exchange rate	−1.15	3.59	−1.28	3.75	−0.52	0.87	−0.58	0.96	−0.85	1.88
7	Total imports	−2.37	−6.40	−2.12	−6.25	−0.52	−1.66	−0.55	−1.75	−2.51	−8.42
8	Bilateral imports	−26.74	−24.79	−25.81	−23.72	−19.91	−16.68	−21.50	−16.76	−32.39	−30.86
9	Total exports	−1.45	−4.46	−1.59	−3.93	−0.66	−0.85	−0.64	−0.90	−1.86	−5.67
10	Bilateral exports	−24.79	−26.74	−23.72	−25.81	−16.68	−19.91	−16.76	−21.50	−30.86	−32.39
11	Import adj. index	6.86	5.01	6.64	4.75	1.97	1.40	2.14	1.40	8.30	6.19
12	Export adj. index	2.89	14.03	2.75	13.71	0.70	3.66	0.70	3.95	3.65	17.40
13	Aggregate inward FDI	7.90	−19.60			1.86	−5.40	2.17	−5.94	5.40	−11.51
14	Bilateral inward FDI	13.31	−13.60			3.26	−3.73	3.66	−4.11	7.94	−8.02

[a] See Table III.

surprising at first, but the difference in the ratios of imports from the bilateral partner to total demand between the two countries could explain this result. In the new U.S.–Japan SAM, U.S. imports from Japan are still considerably greater than Japanese imports from the U.S. In particular, in steel, general machinery, electrical machinery, motor vehicles, and precision instruments, U.S. imports from Japan constitute significant shares of total imports, and the U.S. import dependence on these products is relatively large. Thus the extent by which one could improve its terms of trade against the bilateral partner by restricting imports, the real bargaining leverage in this trade game, is greater for the United States than for Japan.

Removing the asymmetry in intermediate input matrices is found to further weaken the Japanese position in a bilateral tariff war. In contrast to final products, Japan is significantly more dependent than the U.S. on imported intermediate products. In other words, equating the input–output coefficients of Japan to those of the U.S. would reduce Japanese imports from the U.S. This would reduce the terms-of-trade effect of tariffs for Japan, resulting in greater welfare gains for the U.S. and welfare losses for Japan (columns 7–8 in comparison with columns 5–6).

Doubling trade substitution elasticities weakens the market power of each country. While not reported in Table VI, the average optimal tariff for the U.S. declines from 50.0 to 32.1%, while that for Japan decreases from 39.5 to 23.5%. The terms-of-trade effects become smaller, resulting in a smaller welfare gain for the U.S. and a smaller welfare loss for Japan (columns 9–10). Despite the smaller increases in tariffs, reductions in bilateral trade become even larger than those in the baseline case because of greater elasticities of substitution between domestic and foreign goods (columns 9–10, rows 8 and 10).

5.2. Scale Economies and Imperfect Competition

Next, we conduct sensitivity analysis to determine how trade liberalization results depend on the maintained assumptions concerning constant returns to scale and perfect competition. Harris (1984) and Cox and Harris (1985, 1992) have shown that scale economies can exert an important influence on the sectoral and aggregate effects of trade policy, yielding considerably larger welfare effects in the presence of scale economies. To account for this possibility, we relax the assumption of constant returns and allow for increasing returns in manufacturing sectors (3–17). Increasing returns in our model are calibrated to a cost disadvantage ratio given by

$$\mathrm{CDR}_i = \frac{\mathrm{AC}_i - \mathrm{MC}_i}{\mathrm{AC}_i} = \frac{\mathrm{FC}_i}{\mathrm{TC}_i}, \tag{5}$$

where AC_i, MC_i, FC_i, and TC_i are average, marginal, fixed, and total costs, respectively. In the presence of scale economies, fixed costs become positive and are calibrated from

$$\mathrm{FC}_i = \mathrm{CDR}_i[\mathrm{INTC}_i + \mathrm{PVC}_i], \tag{6}$$

where INTC_i and PVC_i are intermediate and primary variable (factor) costs, respectively.

We recalibrate the model as above and then conduct three types of experiment reflecting different assumptions about domestic firm conduct and price formation: (1) contestable market pricing, where a threat of entry forces firms to set their price net of indirect taxes to the average cost; (2) Cournot competition with free entry and exit; (3) Cournot competition with no entry or exit. For illustrative purpose, we have assumed that each manufacturing sector has a cost disadvantage ratio of 10% in all three cases.

Under contestable market pricing,

$$\left(1 - t_{D_i}\right) P_{X_i} = \text{AC}_i. \tag{7}$$

In Cournot competition, a firm faces a perceived demand elasticity equal to $n_i \varepsilon_i$, where n_i is the number of firms and ε_i is the domestic market demand elasticity.[24] It can be shown that, in equilibrium, each firm's percentage markup of the price net of indirect taxes is the inverse of the perceived demand elasticity,

$$1 - \frac{\text{MC}_i}{\left(1 - t_{D_i}\right) P_{X_i}} = \frac{1}{n_i \varepsilon_i}. \tag{8}$$

With free entry and exit, both (7) and (8) are included in the model, and the number of firms becomes endogenous. When firm entry and exit are not allowed, only (8) is added for manufacturing sectors and the number of firms is fixed at the initial value.

The results for bilateral trade liberalization under the three behavioral alternatives are presented in Table VII. By comparing these aggregate adjustments with their constant returns counterparts (experiment 3, Table V), scale economies have little significance as long as firms price at average costs. In both the contestable and Cournot free entry/exit cases, the aggregate results are quite close to those obtained under constant returns. This result contrasts with many other calibrated simulations of trade liberalization under increasing returns, where aggregate welfare effects can increase by orders of magnitude. The reason here is that, despite the existence of unrealized scale economies in the base situation, liberalization induces significant trade diversion from other trading partners, limiting sectoral output adjustments in both countries. Despite this fact, welfare gains for both countries are magnified by increases in per firm domestic output. This effect is substantially stronger for Japan, whose firms export a much larger share of total output to the United States.

The results obtained under Cournot pricing with restricted entry are quantitatively different, but offer no new qualitative conclusions about the virtues of

[24] In order to simplify the model, it is assumed that all firms in a given sector have the same cost structure and are of equal size.

TABLE VII
Aggregate Results of U.S.–Japan Bilateral Liberalization under Increasing Returns in Manufacturing (Percentage Changes unless Indicated Otherwise)

		Contestable market AC pricing		Cournot competition free entry/exit		Cournot competition no entry/exit	
		U.S. (1)	Japan (2)	U.S. (3)	Japan (4)	U.S. (5)	Japan (6)
1	Welfare[a]	17.50	4.33	16.91	4.09	11.50	4.39
2	Real GDP	0.40	0.40	0.38	0.38	0.27	0.34
3	Aggregate TOT	0.19	−0.36	0.19	−0.35	0.17	−0.25
4	Bilateral TOT	1.46	−0.97	1.44	−0.95	1.25	−0.72
5	Bilateral exchange rate	0.74	−0.73	0.72	−0.71	0.49	−0.49
6	ROW exchange rate	0.35	−0.38	0.35	−0.37	0.28	−0.21
7	Total imports	1.44	3.80	1.43	3.77	1.30	3.55
8	Bilateral imports	12.10	23.71	12.04	23.66	11.04	23.29
9	Total exports	2.61	4.46	2.58	4.40	2.34	3.73
10	Bilateral exports	23.71	12.10	23.66	12.04	23.29	11.04
11	Import adj. index	2.75	4.27	2.73	4.27	2.52	4.25
12	Export adj. index	2.79	4.64	2.79	4.64	2.76	4.47
13	Aggregate inward FDI	0.09	5.39	0.08	5.26	0.15	2.89
14	Bilateral inward FDI	−2.02	2.95	−1.97	2.88	−0.93	1.53

[a] See Table III.

increasingly cooperative trade relations between the U.S. and Japan. U.S. firms' ability to price monopolistically substantially reduces the country's domestic gains from liberalization by reducing EV income. At the same time, higher than competitive U.S. domestic prices limits the decline in Japanese terms-of-trade and increases their welfare by comparison to a competitive bilateral pricing scenario.[25]

Thus, we conclude that the specification of industry structure and conduct exert relatively modest influence on the estimated effects of either cooperative or confrontational bilateral trade policies. This is primarily because opportunities for trade diversion limit individual sectoral adjustments. This can be contrasted with results of Harris (1984), for example, where Canada's gains from bilateral liberalization with respect to the U.S. are greatly magnified under increasing returns.[26] Canada's trade shares with the U.S. are extremely large by comparison to Japan's, and thus bilateral trade growth and sectoral output are more highly correlated even when ROW terms-of-trade remain constant.

[25] Although these results are not reported, we also simulated unilateral liberalization under increasing returns. We found that Japan's gains were again greater when the U.S. liberalized unilaterally. In trade war simulations under increasing returns, Japan again suffered substantial losses while the U.S. benefited (but by less than it would gain under bilateral liberalization).

[26] The large welfare effects estimated by Harris (1984) are to some extent attributable to the Eastman–Stykolt pricing assumption used in his model.

6. CONCLUSIONS

This paper presented some new perspectives on the long established trade relationship between the United States and Japan. Although this trade has brought immense prosperity to both nations, occasional acrimony and intransigence have lately given way to more entrenched adversarial feelings. Reasons for this are manifold, including the divisive implications of rising regional trade blocs, persistent disagreements about domestic market access and agriculture, and, most prominently, a chronic bilateral current account imbalance.

We conducted a series of general equilibrium simulation experiments to estimate the effects of bilateral trade conflict and cooperation. Were the two countries to engage in a trade war, bilateral trade would be reduced by about 25% and large trade diversion would occur. Trade-weighted averages of optimal tariff rates are found to be about 50% for the U.S. and 40% for Japan. Our welfare results yield an important asymmetry, however, with the U.S. eventually benefiting from the mutual imposition of reciprocally optimal tariffs. While this result on its face appears negative for those who advocate free trade, it provides the key to overcoming an incentive problem of liberalization.

Our findings on bilateral liberalization indicate that both countries would enjoy an increase in the domestic welfare. Although relatively small in GDP percentage terms, sectoral output and employment growth is significant in many cases, and the U.S. gains are almost nine times those attained from the tariff war. Strategically, however, bilateral liberalization may not be incentive compatible. In particular, Japan gains more from U.S. unilateral tariff reductions and thus has an incentive to limit its commitment to trade liberalization. Because the U.S. has a credible threat of retaliation, however, it can bargain with Japan to implement bilateral cooperation. In other words, the strategic environment is neither completely harmonious nor discordant. Together, these results yield a central policy conclusion that is surprisingly congruent with recent U.S. approaches to trade negotiations with its ally. The U.S. threat of trade retaliation against Japan may be mutually welfare-enhancing, especially if it promotes removal of existing trade barriers, as long as the U.S. never implements restrictive trade policy.

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