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5 Differentiated Products, Economies of Scale, and Access to the Japanese Market

Gary R. Saxonhouse

5.1 The Low Share of Manufactures in Japanese Consumption

By comparison with other advanced industrialized economies (see table 5.1), Japan imports a remarkably small share of the manufactured goods it consumes. Unlike the experience of other advanced industrialized economies, this small share has been virtually constant for decades. This distinctive trade structure is regularly cited by policymakers as evidence that foreign manufacturers are systematically denied access to the Japanese market (McDonald 1982). Foreign manufacturers who have tried unsuccessfully to sell in the Japanese market always concede that formal barriers to imports of manufactured goods are low by any reasonable standard. They argue, however, that the regulatory environment within which most Japanese firms operate allows wide scope for arrangements keeping out those foreign manufactures that are

Table 5.1 Imports of Manufactures as Percentages of Nominal GNP of Selected Countries, 1962–85

	1962	1973	1985
Japan	2.8	2.8	2.7
U.S.	1.3	3.4	6.5
Federal Republic of Germany	6.0	9.1	15.0
France	4.8	9.5	13.1
United Kingdom	4.7	12.0	16.3

Source: Bank of Japan, *Kokusai hikaku tōkei* (International comparative statistics), various issues.

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directly competitive with domestic Japanese production (Schlosstein 1984). These disappointed competitors suggest that it is a mistake to look at lists of vanishing Japanese tariffs and quotas. It is said that a protectionist record can be clearly seen in Japan's distinctive trade structure, which otherwise seems to defy conventional economic explanation.

5.2 What the Theory of Comparative Advantage Tells Us

While a large literature has collected the complaints of foreign manufacturers trying unsuccessfully to sell in Japan, there have also been a number of studies that have attempted to provide an alternative explanation of Japan's distinctive trade structure (Saxonhouse and Stern 1989). This work has investigated how well traditional models of comparative advantage can explain Japanese trade structure. In particular, both Leamer (1984, 1987) and Saxonhouse (1983, 1986) have estimated sectoral trade equations directly derived from Heckscher-Ohlin factor endowment theories of trade structure. Within the Heckscher-Ohlin framework, much of Japan's distinctive trade structure can be explained by Japan's distinctive pattern of factor endowments. If Japanese formal barriers are low and Japan's trade structure can be explained by conventional economic reasoning, it is difficult to take seriously the avalanche of complaints about Japan's supposedly distinctive protectionist trade and industrial policies.

Are such results believable? Their great virtue is that they are nonarbitrary. The specification used in these empirical analyses is dictated by the most widely known and widely taught theory of international trade. This is also their great problem. The assumptions behind the Heckscher-Ohlin framework, which Leamer and Saxonhouse estimate, are severe. This empirical work assumes that national economies differ not in their technologies and preferences but only in their factor endowments. Scale economies and market power are assumed to be absent, and consumption preferences are assumed to be unaffected by income. Factors must be perfectly mobile within countries and totally immobile across national boundaries. Even factor endowments cannot be so dissimilar across countries that each good is not produced in each country.[1]

5.3 What Traditional Theory Leaves Out

Lawrence (1987) has argued persuasively that empirical work on trade barriers using Heckscher-Ohlin equations misses out on at least one critical issue in current policy discussions. Heckscher-Ohlin equations are defined for net trade, yet it is frequently suggested that what is distinctive about Japan's trade pattern is its very meager participation in conventionally defined intraindustry trade in manufacturing (Sazanami 1981). The structure of Japan's net trade flows might appear normal even while, as seen in table 5.2, its gross trade pattern might be highly distinctive.

Table 5.2 Intraindustry Manufacturing Trade Indices, 1980

Country	21 Sectors	94 Sectors
Australia	.41	.22
Belgium	.87	.79
Canada	.67	.68
Finland	.58	.49
France	.88	.82
Germany	.69	.66
Italy	.71	.61
Japan	.30	.25
Netherlands	.77	.78
Norway	.62	.51
Sweden	.66	.68
United Kingdom	.82	.78
United States	.67	.60
Korea	. . .	.48
Switzerland	. . .	.61

Source: Lawrence (1987), using

$$\text{Index } j = \frac{\sum_{i=1}^{n} [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]}{\sum_{i=1}^{n} (X_{ij} + M_{ij})},$$

where i denotes manufacturing category, j denotes country, and X and M are exports and imports, respectively.

It has been argued that this lack of participation in intraindustry trade is at the heart of Japan's diplomatic difficulties during the last ten or fifteen years. The Federal Republic of Germany, which has comparably large net exports of manufactures, is rarely the object of protectionist complaints. Germany is an active participant in intraindustry trade in manufactures. Throughout the postwar period, Germany has imported lots of manufactured products. Perhaps, foreign manufacturers hurt by German competition have difficulty developing a unified position against German trade because, within any foreign manufacturing industry, Germany, by virtue of its manufacturing imports, will have allies to balance against its enemies (Lawrence 1987).

It is difficult to know whether such analyses are good political economy. Trade research that uses net trade as a dependent variable does ignore the possibility that Japanese policy may have worked to keep down both imports *and* exports. From the point of view of the trade policy debate in the United States, however, this may not be a serious omission. This research says that it is unlikely that, compared to other countries, Japanese policy has unfairly kept down imports in dozens of manufacturing sectors unless it is simultaneously keeping down exports in precisely the same sectors. From the American side, U.S.-Japanese economic conflict is surely not about Japan exporting too little, and, from an economic point of view, it is, unhappily, often about quite narrowly defined sectoral trade balances. Economists have learned from American congressmen about the auto deficit, the steel deficit, the textile deficit, and the semiconductor deficit, among others. It would seem that this politically salient part of the trade debate is well handled by investigations that use the Heckscher-Ohlin specification and look at sectoral net trade.

5.4 New Research Findings

Notwithstanding the virtues of looking at sectoral net trade, the determinants of gross imports and gross exports and therefore intraindustry trade also deserve close scrutiny. The very development of the concept of intraindustry trade went hand in hand with the recognition that this type of trade does not reflect comparative advantage. Its existence reflects the importance of product differentiation and scale economies, among other influences. Two economies with very similar factor endowments may still engage in substantial two-way trade if consumers in each have similar tastes for a wide variety of imperfectly substitutable products, most of which are produced under conditions of increasing returns to scale (Helpman and Krugman 1985).

Assume that all manufactured goods are differentiated by country of origin. Given the same identical homothetic preferences usually assumed in the Heckscher-Ohlin research, each economy will consume identical proportions of each variety of each good. This means that country *j*'s consumption of all the different varieties of good *i* can be described by

(1) $$C_{ij} = M_{ij}^{+} + C_{ij}^{j} ,$$

(2) $$M_{ij}^{+} = S_j\left(\overline{Q}_i - Q_{ij}\right),$$

(3) $$C_{ij}^{j} = S_j Q_{ij} ,$$

where[2]

$C_{ij} \equiv$ consumption of good i by country j;

$C_{ij}^{j} \equiv$ consumption of variety j of good i by country j;

$M_{ij}^{+} \equiv$ imports of good i by country j;

$Q_{ij} \equiv$ production of good i in country j;

$\overline{Q}_i \equiv \sum_j Q_{ij} \equiv$ global production of good i;

$\Pi_j \equiv \sum_i \equiv$ GNP of country j;

$$\Pi \equiv \sum_j \Pi_j \equiv \text{global GNP; and}$$

$$S_j \equiv \frac{\Pi_j}{\Pi} \equiv \text{share of country } j \text{ in global GNP.}$$

Equations (2) and (3) can be combined to obtain:

$$(4) \qquad \frac{M_{ij}^+}{M_{ij}^+ + S_j Q_{ij}} = \frac{S_j(\overline{Q}_i - Q_{ij})}{M_{ij}^+ + S_j Q_{ij}} = \frac{S_j(\overline{Q}_i - Q_{ij})}{S_j(\overline{Q}_i - Q_{ij}) + S_j Q_{ij}}$$
$$= \frac{S_j(\overline{Q}_i - Q_{ij})}{S_j \overline{Q}_i} = 1 - \frac{Q_{ij}}{\overline{Q}_i}.$$

Equation (4) states that imports of good i by economy j as a proportion of total use of i by j will be equal to the proportion of good i that is produced outside j. The less competitive a country is in the production of good i, the more it will import.

Alternatively,

$$(4') \quad \frac{M_{ij}^+}{M_{ij}^+ + S_j Q_{ij}} = 1 - \frac{Q_{ij}}{\overline{Q}_i} = 1 - \frac{(1 - S_j)Q_{ij}}{(1 - S_j)\overline{Q}_i} = 1 - \frac{X_{ij}^+}{(1 - S_j)\overline{Q}_i},$$

where $X_{ij}^+ \equiv$ exports of good i by economy j.

Imports of good i by economy j as a proportion of total consumption of i by j will be equal to the proportion of foreign consumption of i that is foreign produced. By global homotheticity, foreign and domestic consumption of any variety of any good will be proportionally the same.

Equations (4) and (4′) provide the basic framework for Lawrence's empirical work on cross-national trade structure. Lawrence, however, does not use cross-national data on trade structure and production to test the restrictions implied by (4) and (4′). Rather, he argues that (4) and (4′) apply only to a world where distance imposes no cost on trade. In a world where transport costs are nonzero and a determinant of trade structure, Lawrence prefers to estimate the logarithmic version of (4) and (4′):

$$(4a) \qquad \log \frac{M_{ij}^+}{M_{ij}^+ + Q_{ij}} = u_i + v_i \log \frac{Q_{ij}}{\overline{Q}_i} + y_i \log T_j$$

and/or

$$(4a') \qquad \log \frac{M_{ij}^+}{M_{ij}^+ + Q_{ij}} = u_i^* + v_i^* \log \frac{X_{ij}^+}{(1 - s_j)\overline{Q}_i} + y_i^* \log T_j\,,$$

where $T_j \equiv$ transport costs or distance and u_i, u_i^*, v_i, v_i^*, y_i, and y_i^* are all parameters.

When estimating (4a) and (4a′), Lawrence finds that he can confirm the impression given by table 5.2. For many manufacturing sectors, Japanese shares of global production and/or of global export markets are too small to explain the small share that imports play in total Japanese consumption. Japan does not appear to be competitive enough abroad to explain why it has such a large market share at home.

Lawrence's work is most attractive in that it allows for important phenomena that cannot be considered by approaches based on the Heckscher-Ohlin framework. His use of production shares and export shares as explanatory variables, however, makes homotheticity the driving force of his interpretation of differences in trade structure. Indeed, his empirical findings can be viewed primarily as a test of this assumption. The quality of this test may be qualified by a number of specification errors.

Quite apart from unresolved issues such as what functional form is appropriate when transport costs are introduced into the Helpman-Krugman model and whether it is appropriate to introduce transport costs at all into an export share version of this model, Lawrence's import share, export share, and production share variables are all jointly determined. The issue of simultaneity here is a very real one. In addition to nontrivial estimation bias, there are some important identification issues. While Lawrence is careful in interpreting his results to suggest that there is something distinctive about Japanese trade structure, he does not make clear why this distinctiveness should be associated with possible Japanese import barriers. For example, in his export share model, out of twenty manufacturing sectors only three appear to have unduly low imports in 1970, but no less than nine do in 1983. Is it really plausible to infer that Japanese protection for manufacturing increased substantially between 1970 and 1983? This is precisely the period when virtually all formal Japanese barriers to the import of manufactured goods were eliminated. If Japanese trade structure did become more distinctive between 1970 and 1983, this can be more properly attributed to increasing foreign barriers to Japanese exports. Japan's import shares of manufactures may be a better index of Japanese competitiveness than its export shares.

5.5 Factor Endowments and Intraindustry Trade

In fact, neither export shares nor production shares need be used as explanatory variables in estimating the Helpman-Krugman model. From (2) and (4′),

$$M_{ij}^{+} = S_j(Q_i - Q_{ij}),$$

$$X_{ij}^{+} = (1 - S_j)Q_{ij}\ ,$$

but

(5) $$S_j = \frac{\Pi_j}{\Pi} = \frac{\sum_s W_{sj} L_{sj}}{\sum_i \overline{Q}_i},$$

where $L_{sj} \equiv$ endowment of factor of production s in economy j and $W_{sj} \equiv$ rental for factor of production s.

Following the approach taken in Heckscher-Ohlin analyses, if factor price equalization is assumed, then, by Hotelling's lemma, if Π_j is differentiated,[3]

(6) $$Q_{ij} = \sum_{s=1}^{K} R_{is} L_{sj},$$

where R_{is} is a function of the parameters of Π_j and output prices, which are assumed to be constant.

Substituting (5) and (6) into the expressions for gross imports and gross exports we get

(7) $$M_{ij}^{+} = \sum_{s=1}^{K} B_{is}^{+} L_{sj} - \sum_{s=1}^{K} \sum_{r=1}^{K} D_{isr}^{+} L_{sj} L_{rj}, \quad i = 1, \ldots, N,$$

(8) $$X_{ij}^{+} = \sum_{s=1}^{K} R_{is} L_{sj} - \sum_{s=1}^{K} \sum_{r=1}^{K} D_{isr}^{+} L_{sj} L_{rj}, \quad i = 1, \ldots, N,$$

where B_{is}^{+} and D_{isr}^{+} are functions of parameters of Π_j and where output prices will be constant under the assumptions already made. The linear factor endowments terms in (7) represent economy j's demand for good i, while the linear terms in (8) represent economy j's supply of good i. The interaction terms in equations (7) and (8) represent economy j's supply of good i. The interaction terms in equations (7) and (8) represent economy j's demand for its domestically produced variety j of good i. The term M_{ij}^{+} in (7) can be interpreted as that part of economy j's demand for good i that cannot be satisfied by the domestically produced variety j. The term X_{ij}^{+} in (7) is the supply of variety j of good i available after domestic demand has been met. Neither M_{ij}^{+} nor X_{ij}^{+} can be negative. If (7) is subtracted from (8), net exports will be given by[4]

(9) $$(X_{ij}^{+} - M_{ij}^{+}) = \sum_{s=1}^{K} (R_{is} - B_{is}^{+}) L_{sj}, \quad i = 1, \ldots, N.$$

Net exports reflect the balance between domestic demand for and supply of good i by economy j. Since domestic demand for the domestic variety of good i appears in both equations (7) and (8), these terms cancel out in equation (9).

By contrast with (7) and (8), (9) is the traditional Heckscher-Ohlin equation with net exports as a linear function of factor endowments (Saxonhouse 1983; and Leamer 1984). Within the Heckscher-Ohlin framework, the nonlinear terms in (7) and (8) cancel out. Since (9) can be derived from the Helpman-Krugman equations (7) and (8), this should demonstrate the compatibility of these two approaches. Contrary to what is often alleged (e.g., Zysman and Tyson 1983, p. 30), the incorporation of scale economies and product differentiation into conventional methods of international trade in order to account for intraindustry trade need not invalidate the Heckscher-Ohlin interpretation of interindustry trade (Helpman and Krugman 1985, p. 131).

Equations (7) and (8) can be estimated in an effort to reconcile the contrasting approaches of Leamer/Saxonhouse and Lawrence. As in the Lawrence approach, equations (7) and (8), by using gross imports or gross exports as a dependent variable, do not net out intraindustry trade. As in the Leamer and Saxonhouse approaches, however, simultaneity problems are avoided by using factor endowments as the central explanatory variables.

The structure embodied in equations (7), (8), and (9) results from relaxing many of the strictest assumptions of the Heckscher-Ohlin model in order to incorporate hitherto neglected phenomena. Still further relaxation of assumptions is possible. For example, suppose that the assumption that strict factor price equalization across countries is dropped. Suppose rather that international trade equalizes factor prices only when factor units are normalized for differences in quality. For example, observed international differences in the compensation of ostensibly unskilled labor may be accounted for by differences in labor quality.[5] Instead of (7), (8), and (9), we have

$$(7')\quad M_{ij}^{+} = \sum_{s=1}^{K} B_{is}^{+} a_s L_{sj} - \sum_{s=1}^{K} \sum_{r=1}^{K} D_{isr}^{+} a_s L_{sj} a_r L_{rj}, \quad i = 1, \ldots, N,$$

$$(8')\quad X_{ij}^{+} = \sum_{s=1}^{K} R_{is} a_s L_{sj} - \sum_{s=1}^{K} \sum_{r=1}^{K} D_{is}^{+} a_s L_{sj} a_r L_{rj}, \quad i = 1, \ldots, N,$$

$$(9')\quad (X_{ij}^{+} - M_{ij}^{+}) = \sum_{s=1}^{K} (R_{is} - B_{is}^{+}) a_s L_{sj}, \quad i = 1, \ldots, N,$$

where $a_s \equiv$ quality of factor s.

5.6 Estimation Procedures

Equation (9′) can be estimated for N commodity groups from cross-national data. The term a_s is not directly observable but can be estimated from (9′). Formally, the estimation of (9′) with a_s differing across countries and unknown is a multivariate, multiplicative errors in variable problem. Instrumental variable methods will allow consistent estimates of the $R_{is} - B_{is}^{+}$. For any given net trade cross section, a_s will not be identified. In the particular specification adopted in (8′), however, at any given time there are N cross sections that contain the identical independent variables. This circumstance can be exploited to permit consistent estimation of the a_s.[6] Since the same error will recur in equation after equation owing to the unobservable quality terms, it is possible to use this recurring error to obtain consistent estimates of the quality terms. These estimates of a_s can then be used to adjust the factor endowment data in (7′) and (8′) to obtain more efficient estimates of R_{is}, B_{is}^{+}, and D_{isr}^{+}.[7] In estimating (7′) and (8′), the D_{isr}^{+} can be constrained to be the same in both equations.

5.7 Estimating an Interindustry Trade Model

Equation (9′) is estimated with data taken from the forty-one countries listed in table 5.3.[8] Equation (9′) is estimated for each of the sixty-one trade sectors listed in table 5.4 for 1979. The six factor endowments used in this estimation include directly productive capital stock, educational attainment, labor, petroleum reserves, coal, and arable land. Unlike Lawrence's work and earlier work by Saxonhouse (1983, 1986), distance is not treated as an independent variable, and the Heckscher-Ohlin equations are assumed to hold up to an additive stochastic term.

Table 5.3 Country Sample for Empirical Work

Argentina	Japan
Australia	South Korea
Austria	Malaysia
Belgium & Luxembourg	Malta
Brazil	Mexico
Canada	Netherlands
Sri Lanka	Nigeria
Cyprus	Norway
Denmark	Philippines
Finland	Portugal
France	Singapore
West Germany	Spain
Greece	Sweden
Honduras	Switzerland
Hong Kong	Thailand
Iceland	Turkey
India	United Arab Republic
Indonesia	United Kingdom
Ireland	United States
Israel	Yugoslavia
Italy	

Table 5.4 Trade Sectors in Sample

Petroleum, petroleum products (PETRO33)	Travel goods, handbags (LAB83)
Crude materials, crude fertilizer (MAT27)	Clothing (LAB84)
Metalliferous ores, metal scrap (MAT28)	Footwear (LAB85)
Coal, coke briquettes (MAT32)	Miscellaneous manufactured articles not elsewhere specified (LAB89)
Gas, natural & manufactured (MAT34)	Postal pack not classified according to kind (LAB91)
Electrical energy (MAT35)	Special transactions not classified according to kind (LAB93)
Nonferrous metals (MAT68)	Coins, nongold, noncurrent (LAB96)
Wood, lumber, cork (FOR24)	Leather, dressed furskins (CAP61)
Pulp, waste paper (FOR25)	Rubber manufactures, not elsewhere specified (CAP62)
Wood, cork manufactures (FOR63)	Textile, yarn, fabrics (CAP65)
Paper, paperboard (FOR64)	Iron and steel (CAP67)
Fruit, vegetables (TROP5)	Manufactures of metal (CAP69)
Sugar, sugar preparations, honey (TROP6)	Sanitary fixtures, fittings (CAP81)
Coffee, tea, cocoa, spices (TROP7)	Machinery, other than electrical (MACH71)
Beverages (TROP11)	Electrical machinery (MACH72)
Crude rubber (TROP23)	Transport equipment (MACH73)
Live animals (ANL0)	Professional goods, watches, instruments (MACH86)
Meat, meat preparations (ANL1)	Firearms, ammunition (MACH95)
Dairy products, eggs (ANL2)	Chemical elements, compounds (CHEM51)
Fish, fish preparations (ANL3)	Mineral tar & crude chemicals from coal, petroleum & natural gas (CHEM52)
Hides, skins, furskins, undressed (ANL21)	Dyeing, tanning, coloring matter (CHEM53)
Crude animal, vegetable minerals (ANL29)	Medicinal, pharmaceutical products (CHEM54)
Animal, vegetable oils, fats, processed (ANL45)	Essential oils, perfume matter (CHEM55)
Animals, not elsewhere specified (ANL94)	Fertilizers, manufactured (CHEM56)
Cereals, cereal preparations (CER4)	Explosives, pyrotechnic products (CHEM57)
Feeding stuff for animals (CER8)	Plastic materials, cellulose (CHEM58)
Miscellanous food preparations (CER9)	Chemical materials, not elsewhere specified (CHEM59)
Tobacco, tobacco manufactures (CER12)	
Oil seeds, oil nuts, oil kernels (CER22)	
Textile fibers (CER26)	
Animal oils, fats (CER41)	
Fixed vegetable oils (CER42)	
Nonmetallic mineral manufactures (LAB66)	
Furniture (LAB82)	

The results of estimating equation (9′) are given in tables 5.5 and 5.6. Note that fifty-four of the sixty-one sectoral net trade regressions are significant. For individual factor endowments, out of sixty-one estimated equations, capital has significant coefficients in twenty-eight, labor has fourteen, education has nineteen, oil has sixteen, coal has twenty-two, and land has twenty-two. Generally speaking, physical capital and human capital are sources of comparative disadvantage in the interindustry trade in natural resource and labor-intensive products and sources of comparative advantage for trade in capital-intensive and machinery products. Labor is a source of comparative disadvantage in interindustry trade in natural resource products. Surprisingly, it has little influence on the trade of what are normally thought to be labor-intensive products. As expected, oil and arable land are sources of comparative

Table 5.5 Estimation of Equation (9′)

$(X^{+}_{ij} - M^{+}_{ij}) = N_0 + N_1\text{CAPITAL} + N_2\text{LABOR} + N_3\text{EDUC} + N_4\text{OIL} + N_5\text{COAL} + N_6\text{LAND ARA}$

	R^2	$F(6/34)$		R^2	$F(6/34)$
PETRO33	.952	112.**	CER42	.096	.60
MAT27	.747	16.8**	LAB66	.574	7.63**
MAT28	.798	22.4**	LAB82	.202	1.44
MAT32	.835	28.6**	LAB83	.535	26.52**
MAT34	.461	4.78**	LAB84	.413	3.99**
MAT35	.295	2.37**	LAB85	.515	6.02**
MAT68	.687	12.4**	LAB89	.754	17.4**
FOR24	.652	10.6**	LAB91	.540	6.64**
FOR25	.424	4.18**	LAB93	.5701	7.51**
FOR63	.476	5.15**	LAB96	.137	.90
FOR64	.305	2.48**	CAP61	.591	8.19**
TROP5	.428	4.24**	CAP62	.850	32.2**
TROP6	.699	13.2**	CAP65	.590	8.16**
TROP7	.683	12.2**	CAP67	.848	31.6**
TROP11	.697	13.0**	CAP69	.891	46.4**
TROP23	.177	1.22	CAP81	.309	2.54**
ANL0	.045	.27	MACH71	.843	30.3**
ANL1	.454	4.71**	MACH72	.928	72.5**
ANL2	.115	.74	MACH73	.930	75.3**
ANL3	.953	116.**	MACH86	.700	13.2**
ANL21	.587	8.05**	MACH95	.953	114.**
ANL29	.334	2.84**	CHEM51	.693	12.8**
ANL43	.323	2.71**	CHEM52	.382	3.51**
ANL94	.436	4.38**	CHEM53	.510	5.89**
CER4	.942	92.7**	CHEM54	.599	8.47**
CER8	.653	10.7**	CHEM55	.650	10.6**
CER9	.403	3.82**	CHEM56	.240	1.78
CER12	.823	26.3**	CHEM57	.573	7.60**
CER22	.894	47.6**	CHEM58	.689	12.6**
CER26	.739	16.1**	CHEM59	.793	21.7**
CER41	.865	36.5**			

**$F(6, 34)_{.05} = 2.34$.

advantage for trade in natural resources and sources of comparative disadvantage for trade in virtually all manufactured products. By contrast, coal is a source of comparative disadvantage for most natural resource products, save coal itself, and a source of comparative advantage for trade in machinery and chemicals.

Apart from their statistical significance, how important are each of these variables in explaining trade structure? Table 5.7 presents beta coefficients for each of the six explanatory variables for each of the sixty-one net trade equations (Kmenta 1986, pp. 422–23). These beta coefficients are directly proportional to the contribution that each variable makes to a prediction of net trade (Leamer 1978). Since equations such as (9′) are used to predict Japanese trade structure, these results are of particular interest.

Table 5.6 Numbers of Significant (.05) Coefficients in Equation (9′) by Sectoral Grouping, Factor Endowment, and Sign

	Capital		Labor		Education		Petroleum		Coal		Land	
	+	−	+	−	+	−	+	−	+	−	+	−
(7) Petroleum and raw materials (PETRO33, MAT27–68)	...	3	...	1	...	1	2	...	1	...	2	...
(4) Forest products (FOR24–63)	...	1	...	...	...	...	...	...	...	1	1	...
(5) Tropical products (TROP5–23)	...	3	1	...	...	3	...	2	...	3	2	...
(8) Animal products (ANL0–94)	...	3	...	...	...	1	1	...	...	...	2	...
(8) Cereals (CER4–42)	1	1	1	...	...	3	3	...	1	...	4	...
(9) Labor-intensive manufactures (LAB66–96)	1	1	1	...	1	1	...	2	1	2	...	1
(6) Capital-intensive manufacturing (CAP61–81)	4	...	1	1	3	...	...	2	2	1	...	3
(5) Machinery (MACH71–95)	4	...	2	1	4	...	1	...	4	...	...	4
(9) Chemical products (CHEM51–59)	4	2	3	2	2	1	...	3	6	...	...	4

Note: Numbers in parentheses at the left of sectoral grouping rows indicate the number of equations in each sectoral grouping.

Table 5.7 **Beta Values from Equation (9′)**

	N_1	N_2	N_3	N_4	N_5	N_6
PETRO33	−1.16	−.20	.22	.68	−.15	−.15
MAT27	−.63	−.75	−.20	1.09	−.13	.85
MAT28	−1.62	1.42	−1.79	−.45	−.48	1.93
MAT32	−.83	−.68	−.26	−.21	1.85	.48
MAT34	−.94	.97	−.91	.10	−.96	.86
MAT35	.48	−1.15	.21	1.06	−1.12	.71
MAT68	.41	−2.36	.71	.32	.01	.62
FOR24	−1.59	.88	−.88	.58	−.24	.75
FOR25	.48	−1.19	−.02	.97	−1.33	1.12
FOR63	−.11	−1.31	.16	.36	−.17	.74
FOR64	1.16	−1.76	−.48	.88	−1.26	.71
TROP5	−.29	−.28	−.22	.96	−1.20	.94
TROP6	−.86	1.19	−1.59	−1.70	−.22	1.91
TROP7	−1.02	1.48	−.62	−.20	−1.08	.42
TROP11	−1.47	4.57	−2.60	−1.77	−1.54	1.01
TROP23	−.13	.83	1.04	1.13	−.07	−1.00
ANL0	−.38	.71	−.62	−.42	.18	.38
ANL1	−.28	−.52	−.58	−.10	−.43	1.37
ANL2	.06	.52	−.98	−.42	−.85	1.21
ANL3	−1.15	.21	.20	.64	−.13	−.12
ANL21	−.91	.32	−.80	.14	.44	.90
ANL29	−.88	.82	−.54	.54	−1.05	.65
ANL43	−1.69	1.58	−.96	−.16	.29	.22
ANL94	−2.06	2.22	−1.50	−.61	.52	.58
CER4	−.33	.69	−1.22	.18	−.20	1.24
CER8	−.77	.98	−.66	.62	−.48	.73
CER9	.15	−.07	−.09	.32	.21	.09
CER12	−.75	.47	−.47	.78	−.04	.57
CER22	.00	.02	.01	.00	.29	.01
CER26	−.68	−.15	−1.18	−.66	.78	1.79
CER41	.41	−.99	−.14	.68	.00	.91
CER42	−.33	−.37	.38	.80	−.04	−.31
LAB66	.01	.62	.25	−1.11	.63	−.81
LAB82	.51	−1.52	1.18	−.15	1.12	−.95
LAB83	−.09	.01	.24	−.02	−.57	−.20
LAB84	−.50	.47	−.13	.11	−.75	.13
LAB85	−.28	.87	−.42	−.31	−1.03	.31
LAB89	1.23	−1.28	1.56	−.22	.44	−1.50
LAB91	−2.18	3.91	−1.48	−1.34	1.06	−.82
LAB93	−.18	1.66	−.95	−.57	−1.61	.63
LAB96	.57	−1.74	1.05	.62	.82	−.57
CAP61	−.90	1.84	−.47	−.75	−.56	.70
CAP62	.75	1.27	−.12	−1.00	−.67	−.55
CAP65	1.67	−1.72	1.85	.38	.08	−1.20
CAP67	2.69	−2.88	1.91	.08	−.13	−.80
CAP69	1.62	−1.00	1.04	−.88	.88	−1.04
CAP81	.45	−.55	.69	−.36	1.25	−.95

(continued)

Table 5.7 (continued)

	N_1	N_2	N_3	N_4	N_5	N_6
MACH71	1.07	−1.27	1.08	−.17	1.60	−1.19
MACH72	2.22	−2.15	1.79	−.02	.67	−1.36
MACH73	2.12	−1.41	1.22	−.31	.16	−.88
MACH86	2.08	−2.86	2.26	.62	.97	−1.63
MACH95	−.18	.35	−.17	.54	.46	−.12
CHEM51	1.58	−2.71	1.61	.13	1.76	−1.04
CHEM52	−.70	.07	−.63	.92	−1.00	.71
CHEM53	.63	−1.09	.87	−.89	2.05	−1.06
CHEM54	−1.22	2.22	−1.04	−.96	1.33	−.43
CHEM55	−1.57	4.35	−2.27	−1.72	.29	.27
CHEM56	1.45	−3.15	1.35	1.16	.20	−.29
CHEM57	−1.46	2.98	−1.21	−1.04	1.05	−.56
CHEM58	1.38	−1.82	1.45	.16	1.30	−1.24
CHEM59	.21	−.53	.54	−.37	1.99	−.99

The beta values in table 5.7 indicate the amount of change in standard deviation units of the net trade variable induced by a change of one standard deviation in the factor endowment. Following Leamer, if 0.5 is defined as a significant beta value, then education or human capital is significant in fifty-one out of sixty-one net trade equations. Arable land is significant forty-seven times, labor forty-three times, capital forty-one times, coal thirty-four times, and oil thirty-three times.

5.8 Cross-national Differences in Factor Quality and Measurement Error

In table 5.8, Hausman's (1978) Test is used to check for unmeasured differences in factor quality and other errors in factor measurement across countries. In no less than forty-two out of a total of sixty-one sectoral trade equations, the hypothesis that there are no cross-national unmeasured differences in factor quality cannot be accepted. This result is hardly surprising in view both of the quality of the data being used and of the widely observed differences across countries in the compensation of ostensibly similar factors of production. In consequence, using the multiplicative errors in variables methods previously outlined, these differences have been estimated.

Cross-national estimate of factor quality and measurement error for forty-one countries are presented in table 5.9. These estimates are very difficult to interpret. They do not conform to any a priori beliefs about the relative quality of the various factors of production across countries. Cypriot, Honduran, Icelandic, and Maltese workers are not credibly three or four times more efficient than their American counterparts. Rather, these estimates may be dominated by errors of measurement that simply reflect poor data collection. For some countries, the estimated a_s may also reflect government policies aimed not so much as protecting particular sectors as at protecting

Table 5.8 Hausman's Test on Factor Endowments, *F*-Test on Errors in Capital, Labor, and Education Variables

PETRO33	31.82*	CER42	1.44
MAT27	12.38*	LAB66	1.69
MAT28	21.97*	LAB82	3.94*
MAT32	2.00	LAB83	3.10*
MAT34	4.81*	LAB84	1.64
MAT35	3.54*	LAB85	6.85*
MAT68	1.68	LAB89	2.77*
FOR24	2.71*	LAB91	44.37*
FOR25	3.05*	LAB93	3.71*
FOR63	2.90*	LAB96	.81
FOR64	1.10	CAP61	2.36*
TROP5	7.74*	CAP62	8.62*
TROP 6	.32	CAP65	3.43*
TROP7	3.51*	CAP67	4.31*
TROP11	1.05	CAP69	6.32*
TROP23	1.59	CAP81	5.07*
ANL0	27.30*	MACH71	3.28*
ANL1	5.64*	MACH72	12.89*
ANL2	1.17	MACH73	27.75*
ANL3	1.17	MACH86	8.68*
ANL21	.23	MACH95	1.99
ANL29	1.54	CHEM51	7.52*
ANL43	8.48*	CHEM52	5.62*
ANL94	14.13*	CHEM53	11.41*
CER4	1.11	CHEM54	4.28*
CER8	7.01*	CHEM55	.81
CER9	6.15*	CHEM56	6.11*
CER12	10.70*	CHEM57	3.53*
CER22	13.89*	CHEM58	3.46*
CER26	10.35*	CHEM59	1.78
CER41	2.95*		

*Significant at .05 level.

particular factors of production. For example, Indonesian capital may greatly benefit by government policy at the expense of skilled and unskilled labor, while Turkish, Norwegian, and Danish labor may benefit at the expense of capital. It is also possible that some of the unusual findings in table 5.9 are purely artifacts of the estimation procedures used. Cyprus, Honduras, Iceland, and Malta, with by far the highest measured factor efficiency, also have the smallest factor endowments of capital and skilled and unskilled labor in the forty-one-country sample. While using rank order by size of factor endowments generates instruments that, in general, are closely correlated with the factor endowments, some countries obviously remain outliers.[9]

5.9 Estimating an Intraindustry Model of Trade

Unlike the net trade equation (9′), the dependent variables in the gross trade equations (7′) and (8′) will never be negative, but they will occasionally be

Table 5.9 **Cross-national Estimates of Factor Quality and Measurement Error a_s**

	Capital	Labor	Education
Argentina	.96	1.17	1.18
Australia	1.08	1.09	1.26
Austria	.87	1.28	1.23
Belgium & Luxembourg	.98	1.36	1.18
Brazil	.71	.70	.83
Sri Lanka	2.48	1.07	1.36
Cyprus	4.13	3.76	5.04
Denmark	.85	1.51	.89
Finland	.95	1.33	.93
France	.76	1.00	.82
West Germany	1.15	1.03	1.06
Greece	.78	1.13	1.39
Honduras	4.07	2.35	3.01
Hong Kong	1.78	1.22	1.30
Iceland	3.13	4.16	3.62
India	1.37	.91	1.00
Indonesia	2.62	.83	.79
Ireland	2.61	1.57	1.44
Israel	1.40	1.38	1.17
Italy	.93	.94	.87
Japan	.93	.89	.94
Korea	1.22	.83	1.09
Malaysia	1.69	.99	1.04
Malta	5.01	3.97	4.16
Mexico	1.16	.98	1.02
Netherlands	.87	1.13	.82
Nigeria	1.93	1.02	1.10
Norway	.78	1.54	1.09
Philippines	1.40	.67	.85
Portugal	1.53	1.41	1.43
Singapore	1.67	1.70	1.48
Spain	.77	1.06	1.11
Sweden	1.00	1.32	.89
Switzerland	.95	1.38	1.03
Thailand	1.13	.85	1.31
Turkey	.82	1.43	1.36
United Arab Republic	1.56	1.33	.86
United Kingdom	10.99	.76	.85
United States	1.00	1.01	1.01
Yugoslavia	1.14	.84	.91

zero. As seen in table 5.10, some of the import equations and most of the export equations will contain some zero observations. This suggests that equations (7′) and (8′) should be specified as a Tobit model.[10]

The presence of factor endowment interaction terms in equations (7′) and (8′) presents additional estimation problems. Given the available sample size and the large number of interaction terms, multicollinearity among the

Table 5.10 Proportion of Zero Observations in Gross Trade Equations

	Imports	Exports		Imports	Exports
PETRO33	0	.073	CER9	0	0
MAT27	0	.024	CER12	.049	.049
MAT28	0	.195	CER22	.024	.073
MAT32	0	.195	CER26	0	0
MAT34	.049	.268	CER41	0	.146
MAT35	.634	.683	CER42	0	.049
MAT68	0	0	CAP61	0	0
FOR24	0	.098	CAP62	0	.024
FOR25	.049	.098	CAP65	0	0
FOR63	0	0	CAP67	0	.049
FOR64	0	0	CAP69	0	0
TROP5	0	.024	CAP81	0	.049
TROP6	0	.049	MACH71	0	.024
TROP7	0	.024	MACH72	0	.049
TROP11	0	.049	MACH73	0	.024
TROP23	0	.122	MACH86	0	.049
ANL0	.268	NA	MACH95	.171	.366
ANL1	.024	.024	CHEM51	0	.024
ANL2	0	.073	CHEM52	0	.220
ANL3	0	0	CHEM53	0	0
ANL21	.073	0	CHEM54	0	.024
ANL29	0	0	CHEM55	0	.024
ANL43	0	.122	CHEM56	.024	.146
ANL94	0	.122	CHEM57	0	.146
CER4	0	.024	CHEM58	0	.049
CER8	0	0	CHEM59	0	0

independent variables is likely to make precise estimation difficult.[11] In order to avoid this problem, recall that from (5) and (7′) that

$$M_{ij}^{+} = \sum_{s=1}^{K} B_{is}^{+} a_s L_{sj} - \sum_{s=1}^{K} \sum_{r=1}^{K} D_{irs}^{+} a_s L_{sj} L_{rj}$$

$$= \frac{\Pi_j}{\Pi} \overline{Q}_i - \frac{\Pi_j}{\Pi} \sum_{s=1}^{K} R_{is} a_s L_{sj} .$$

Dividing through by Π_j we get

$$(10') \qquad \frac{M_{ij}^{+}}{\Pi_j} = \frac{\overline{Q}_i}{\Pi} - \frac{1}{\Pi} \sum_{s=1}^{K} R_{is} a_s L_{sj} = F_i - \sum_{s=1}^{K} R_{is}^{*} a_s L_{sj} ,$$

where $F_i \equiv \overline{Q}_i/\Pi \equiv$ global sector i as a proportion of global GNP and $R^*_{is} \equiv R_{is}/\Pi$.

Equation (10′) makes it very easy to demonstrate that, in a world with intraindustry trade, trade volume as a proportion of GNP can vary. By contrast, in the Heckscher-Ohlin world of equation (9′), trade volume as a proportion of GNP cannot vary. From (10′) it is clear that, if two economies are alike in all respects except size, the larger economy will have the relatively smaller foreign trade sector.

The results of estimating (10′), using the quality adjusted factor endowment data but excluding Japan from the sample, are presented in tables 5.11 and 5.12. In general, the results are interesting, occasionally surprising, but mostly plausible. For example, forty-nine out of sixty-one gross import regressions are statistically significant. These results mean that it is possible to get a good explanation of the commodity structure of intraindustry trade even without any treatment of distance between trading partners.

Table 5.11 **The Estimation of $P_0 + P_1$CAPITAL $+ P_2$LABOR $+ P_3$EDUC $+ P_4$OIL $+ P_5$COAL $+ P_6$LAND ARA**

	R^2	$F(6/33)$		R^2	$F(6/33)$
PETRO33	.999	6610.00**	CER42	.746	18.3**
MAT27	.378	3.34**	LAB66	.646	10.0**
MAT28	.149	.97	LAB82	.280	2.14
MAT32	.120	.75	LAB83	.796	21.4**
MAT34	.059	.34	LAB84	.483	5.14**
MAT35	.085	.51	LAB85	.430	4.14**
MAT68	.502	5.55***	LAB89	.805	22.7**
FOR24	.475	4.99**	LAB91	.033	.18
FOR25	.205	1.42	LAB93	.362	3.12**
FOR63	.589	7.89**	LAB96	.370	3.23**
FOR64	.523	6.10**	CAP61	.545	6.58**
TROP5	.820	25.1**	CAP62	.454	4.57**
TROP6	.420	3.98**	CAP65	.818	24.7**
TROP7	.716	13.9**	CAP67	.815	24.2**
TROP11	.607	8.49**	CAP69	.780	19.5**
TROP23	.920	62.8**	CAP81	.705	13.2**
ANL0	.688	12.1**	MACH71	.864	34.9**
ANL1	.570	7.28**	MACH72	.903	51.3**
ANL2	.582	7.65**	MACH73	.914	58.6**
ANL3	.999	1870.0**	MACH86	.792	20.9**
ANL21	.076	.46	MACH95	.132	.84
ANL29	.654	10.4**	CHEM51	.374	3.28**
ANL43	.899	48.7	CHEM52	.064	.38
ANL94	.691	12.3**	CHEM53	.834	27.6**
CER4	.397	3.62**	CHEM54	.466	4.80**
CER8	.435	4.23**	CHEM55	.711	13.5**
CER9	.536	6.34**	CHEM56	.108	.66
CER12	.395	3.59**	CHEM57	.738	15.5**
CER22	.243	1.77	CHEM58	.255	16.9**
CER26	.559	6.97**	CHEM59	.416	3.92**
CER41	.067	.39			

**Significant at the .05 level, $F(6,33)_{.05} = 2.33$.

Table 5.12 **Number of Significant (.05) Coefficients in Equation (10′) by Sectoral Grouping and Factor Endowment and Sign**

	F_i	Capital		Labor		Education		Oil		Coal		Arable Land	
		+	−	+	−	+	−	+	−	+	−	+	−
(7) Petroleum and raw materials (PETRO33, MAT27–68)	3	2	1	1	1	1	1	...	2	...	1	...	2
(4) Forest products (FOR24–63)	2	1	...	2	1	...	2	...	2	...	...	2	...
(5) Tropical products (TROP5–23)	5	3	1	1	3	2	2	3	1	1	3	...	...
(8) Animal products (ANL0–94)	7	4	2	2	3	4	1	4	2	4	2	1	5
(8) Cereals (CER4–42)	6	3	2	...	4	3	2	1	2	1	3	0	5
(9) Labor-intensive manufactures (LAB66–96)	7	3	2	...	6	3	2	3	2	3	2	2	3
(6) Capital-intensive manufactures (CAP61–81)	6	2	4	2	2	2	3	3	2	1	3	3	1
(5) Machinery (MACH71–95)	4	1	3	1	2	1	3	1	1	...	4	2	2
(9) Chemical products (CHEM51–59)	7	2	5	1	4	1	3	3	1	...	5	3	1

Note: Numbers in parentheses at the left of sectoral grouping rows indicate the number of equations in each sectoral grouping.

The results here also appear to be generally in accord with the theory motivating equation (10′). Since it is impossible to have imports of a product that is nowhere produced, from (10′) it is clear that F_i, the constant term in this equation, should be positive. In fifty out of the sixty-one estimated gross import share equations, the F_i are statistically significantly greater than zero. From (6), it is also clear that the signs of the coefficients on the factor endowments in (10′) will be opposite to those of the corresponding second derivatives of the GNP function. This means that at least some of the sixty-one coefficients on each factor endowment in (10′) are negative and that in the absence of widespread specialization by sector at least some of the coefficients on factor endowments in each of the sixty-one import equations will also be negative (Diewert 1974, p. 143). As estimated, equation (10′) meets both these conditions.

For individual factor endowments, by marked contrast with the estimated interindustry trade model, the intraindustry trade model has a great many more significant coefficients. What are the determinants of gross imports? Capital once again has the most significant coefficients with forty-three, education has thirty-three, oil has thirty-four, and coal, land, labor all have thirty-five. The determinants of gross imports do appear quite similar to the determinants of net trade. Endowments of capital and human capital do encourage imports of natural resource products and labor-intensive products while discouraging imports of capital-intensive, machinery, and chemical products. As expected, arable land has just the opposite effect. Perversely, endowments in labor do appear to discourage imports of what are thought to be labor-intensive products along with the imports of most natural resource products. Factor endowments of oil, while encouraging net exports of many natural resource products, with the obvious exception of energy products, do encourage the gross imports of natural resource products. Coal's effect is just the opposite. With the exception of energy products, endowments of coal appear to encourage net imports of natural resource products. At the same time, however, they appear to discourage gross imports of these products.

5.10 Is Japanese Trade Behavior Distinctive?

Equation (10′) has been estimated without using Japanese observations.[12] Following earlier work by Saxonhouse (1983, 1986), forecasts are made successively on Japanese, Canadian, U.S., and Korean sectoral import shares using equation (10′). These forecasts are then compared with actual import shares. To the extent that equation (10′), estimated with non-Japanese evidence, can replicate Japan's trade structure, it is difficult to argue that Japanese sectoral policies are yielding distinctive outcomes. This does not necessarily mean that Japan has a liberal trade regime. If all countries with relatively small amounts of arable land protect their wheat growers, Japan's behavior will not be seen as distinctive. At the same time under these circumstances, a change in Japanese trade policy will yield an increase in Japanese wheat imports. It should also be understood that, even if equation (10′) cannot replicate Japan's trade structure, such a failure cannot necessarily be attributed to Japanese trade barriers. There may be other important variables, besides trade barriers, that have been excluded from the model underlying equation (10′).

The results of estimating (10′) are presented in tables 5.13 and 5.14. Of the sixty-one actual observations on Japanese import shares, only eight do not appear to come from the same population used to estimate (10′). These findings for gross import shares appear broadly consistent with earlier findings by Leamer and Saxonhouse for net trade. Japanese sectoral policies do not appear to be yielding distinctive outcomes.

Tables 5.13 and 5.14 contain findings for individual sectors. In order to test the null hypothesis that the ex post forecasts on all the extra sample values of

Table 5.13 Extreme Observations on Imports, 1979

Japan:	United States:
Wood, lumber, cork	Metalliferous ores
Wood, cork, manufactures	Petroleum products
Meat, meat preparation	Plastic materials
Dairy products & eggs	Rubber manufactures, not elsewhere specified
Feedstuff for animals	Textile yarn, fabrics
Tobacco, tobacco products	Clothing
Clothing	Footwear
Footwear	
Canada:	**Korea:**
Dairy products, eggs	Coal, coke briquettes
Fish, fish prepartion	Fruit, vegetables
Oil seeds, oil nuts, oil kernels	Cereals, ceral preparation
Wood, lumber, cork	Tobacco, tobacco manufactures
Wood, cork manufactures	Oil seeds, oil nuts, oil kernels
Leather, dressed	Textile fibers
Rubber manufactures	Hides, skins, furskins, undressed
Paper, paperboard, & manufactures	Crude animals, vegetables, minerals
Textile yarn, fabrics	Wood, lumber, cork
Manufactures of metal machinery	Wood, cork manufactures
	Footwear
	Rubber manufactures, not elsewhere specified
	Metal manufactures
	Machinery, other than electrical
	Electrical machinery
	Transport equipment
	Plastic materials, cellulose
	Chemical materials, not elsewhere specified

Table 5.14 Does Forecasted $\frac{M_{ij}}{\Pi_j}$ Come from the Same Population as Actual $\frac{M_{ij}}{\Pi_j}$?

	Japan	United States	Canada	Korea
PETRO33	.33	2.38*	.67	.67
MAT27	.84	.84	.91	1.41
MAT28	1.56	2.53*	.89	1.25
MAT32	1.07	1.85	1.36	3.16*
MAT34	1.50	.61	1.28	1.48
MAT35	.74	1.21	1.03	1.19
MAT68	1.37	1.02	1.84	1.02
FOR24	2.14*	1.56	2.61*	2.68*
FOR25	.85	1.36	1.50	1.61
FOR63	2.68*	.28	2.50*	4.51*
FOR64	1.08	.74	3.02*	1.03
TROP5	.19	.04	1.08	2.87*
TROP6	1.08	1.02	.84	1.02
TROP7	.06	1.71	1.36	1.50
TROP11	.61	.28	1.48	.42
TROP23	.17	.34	1.33	.28
ANL0	.63	.02	.79	.68
ANL1	2.85*	1.03	.81	.41
ANL2	2.31*	1.63	2.21*	.54
ANL3	1.43	.35	.02	.42
ANL21	1.02	.51	1.46	.07
ANL29	.67	.55	1.27	3.11*
ANL45	.41	.94	1.02	.82
ANL94	.77	1.48	.81	1.19
CER4	.48	.41	.59	.50
CER8	2.96*	.81	1.27	.92
CER9	.27	.83	.80	.94
CER12	2.51*	.81	1.01	.02
CER22	.31	.25	3.41*	4.32*
CER26	.34	.47	.27	2.90*
CER41	.36	.47	1.26	.43
CER42	.51	.77	.21	.89
LAB66	.61	.87	.97	.85
LAB82	.85	.33	.69	.69
LAB83	.85	.41	.87	.96
LAB84	2.38*	2.64*	.68	1.89
LAB85	3.09*	3.16*	.43	1.15
LAB89	1.17	.48	.71	.66
LAB91	.69	.24	.57	.52
LAB93	.65	.37	.60	1.04
LAB96	.09	.09	.11	.06
CAP61	.11	.75	2.80*	1.64
CAP62	.08	2.67*	3.24*	2.98*
CAP65	.35	3.50*	.67	1.18
CAP67	1.23	1.44	1.84	.28
CAP69	.69	.61	2.73*	2.27*

Table 5.14 (continued)

	Japan	United States	Canada	Korea
CAP81	.01	.93	.85	1.28
MACH71	.97	1.02	.28	6.18*
MACH72	.69	.61	.91	3.76*
MACH73	.38	.87	.01	6.59*
MACH86	.67	.63	1.21	1.50
MACH95	.88	.39	.96	1.11
CHEM51	.77	1.23	.60	1.16
CHEM52	.21	.54	.56	1.06
CHEM53	.01	.46	.37	.77
CHEM54	.22	.44	.05	1.49
CHEM55	.55	.93	.57	.95
CHEM56	1.36	1.07	1.04	1.07
CHEM57	.62	1.00	.82	.86
CHEM58	.54	2.51*	.66	4.73*
CHEM59	1.42	1.48	1.39	3.20*

*Hypothesis that forecast and historical values come from same population not accepted (critical region = .05) using t-tests.

Japanese, Canadian, Korean, and U.S. trade structure, respectively, do not differ significantly from their historical values, the chi-square test statistic

(11) $$P = \sum_{i=1}^{61} [(\hat{\phi}_{ij} - \phi_{ij})/\hat{\sigma}_{\phi ij}]^2 ,$$

where $\hat{\phi}_{ij}$ ≡ forecast of gross imports/GNP in the i^{th} sector in the j^{th} country, where ϕ_{ij} ≡ actual value of gross imports/GNP in the i^{th} sector in the j^{th} country, ≡ and where $\hat{\sigma}_{\phi ij}$ ≡ estimated standard error can be utilized. Since the calculated values of P for Japan, Canada, Korea, and the United States are 89.3, 114.3, 227.6, and 95.4 respectively, for 1979 and the 5 percent critical value is 109.4, it is apparent that for Japan and the United States the null hypothesis cannot be rejected. As before, this suggests whatever Japanese (and American) trade policies (and/or informal barriers) may have been, more than likely they have not been a major determinant of trade patterns. Further investigation of the Canadian and Korean results are clearly in order.

5.11 Conclusions

On the basis of the preceding research, it appears that the removal of the remaining distinctive formal and informal Japanese sectoral barriers to the import of manufactures, while highly desirable from a diplomatic standpoint, may have little effect on Japanese trade structure. Japan's intraindustry trade pattern, like Japan's interindustry trade pattern, looks globally distinctive. When full allowance is made for economies of scale, differentiated products, and Japan's distinctive national endowments, however, Japan's intraindustry trade, like Japan's interindustry trade and like American trade, does conform to international patterns. If Japan is protectionist, it is protectionist in the same ways that other advanced, industrialized countries with scarce natural resources are protectionist. Whatever Japanese trade and industrial policies may have been in the 1950s, 1960s, and 1970s, by the late 1970s it is difficult to find evidence of their distinctive, lasting effect on Japanese trade structure.

Appendix A
Data Sources and Methods

Directly Productive Capital Stock

Benchmarks for 1960 for each of the countries in the sample are estimated by cumulating gross domestic capital formation excluding residential housing investment and inventories from 1948. Estimates of real gross domestic capital formation in common currency terms are available in Robert Summers, Irving Kravis, and Alan Heston, "International Comparison of Real Product and Its Components," *Review of Income and Wealth* ser. 26, no. 1 (March 1980). Residential housing investment and inventories are subtracted from these estimates. These data are available from the World Bank national accounts data sheets for 1950, 1955, and 1960. They are converted to common currency basis using the Summers, Kravis, and Heston purchasing power parity estimates for investment goods. For both the aggregate series and its components, missing years are interpolated. It is assumed that the average annual rate of growth of gross domestic capital formation is the same for 1948–50 as for 1950–55. Gross domestic capital formation is converted to net domestic capital formation by assuming an average asset life of twelve years and applying the appropriate depreciation factor. A capital stock series for 1959–79 is created by using World Bank data following these same procedures.

Labor Force

Benchmarks for 1979 for each of the countries in the sample are taken from the economically active population data given in International Labor Organization, *Yearbook of Labor Statistics* (Geneva: International Labor Organization).

Educational Attainment

Benchmarks for 1979 for each of the countries in the sample (1968 for France, 1971 for the Netherlands, and 1971 for the United Kingdom) are constructed using country-specific survey of labor force data. Occupational groups in each country are aggregated using weights taken from Laurits Christensen, Diane Cummings, and Dale W. Jorgenson, "Economic Growth, 1947–1973: An International Companson," in *New Development in Productivity Measurement and Analysis*, ed. John W. Kendrick and Beatrice Vaccara (Chicago: University of Chicago Press, 1980), 595–698.

Petroleum Resources and Coal Resources

Benchmarks for 1968 for each of the countries in the sample are obtained from the United Nations.

Petroleum resources series and coal resourres series for 1959–79 are created by adding or subtracting where appropriate crude petroleum production to the benchmarks. These production data are taken from United Nations, *Yearbook of World Energy Statistics* (New York: United Nations).

Arable Land

Arable land data are available in Food and Agricultural Organization, *Production Yearbook* (Rome: Food and Agriculture Organization).

Trade Data

Trade data are available in United Nations, *Commodity Trade Statistics* (New York: United Nations), and *Yearbook of International Trade Statistics* (New York: United Nations). Some reclassification because of a change in the SITC (Standard Industrial Trade Classification) system in 1960. Trade flows are converted to U.S. dollars using prevailing exchange rates. Trade flows in current U.S. dollars are deflated using U.S. export and import price indices. The price indices used are more aggregated than the commodity breakdown employed in the analysis here.

Appendix B
Estimating Equations (7′) and (8′)

The results of estimating (7′) and (8′) jointly, using the quality adjusted factor endowment data, but excluding Japan from the sample, are presented in table 5B.1. Tables 5B.2 and 5B.3 present the results of tests on the explanatory power of equations (7′) and (8′). As reported in table 5B.2, fifty- nine out of a total of sixty-one sectoral trade relationships are significant. In table 5B.3 we test whether the nonlinear terms in equations (7′) and (8′), taken together, contribute significantly to the explanation of gross trade flows. Does the

Table 5B.1 **Numbers of Significant (.05) Coefficients in Equations (7′) and (8′) by Sectoral Grouping and Factor Endowment**

		Linear Terms						Interaction Terms					
		Capital	Labor	Education	Petroleum	Coal	Land	Capital	Labor	Education	Petroleum	Coal	Land
Petroleum and Raw Materials (PETRO33 MAT27–68)	M	3	1	2	3	3	3	6	3	2	8	3	3
	X	4	2	1	1	4	2						
Forest Products (FOR24–63)	M	1	2	2	2	0	3	9	5	7	8	7	5
	X	3	3	1	0	0	3						
Tropical Products (TROP5–23)	M	2	0	1	1	2	2	7	3	4	2	2	1
	X	1	0	0	2	1	3						
Animal Products (ANL0–94)	M	1	2	4	0	3	4	12	9	7	3	3	2
	X	2	1	4	4	1	1						
Cereals (CER4–42)	M	0	0	0	1	4	6	6	5	4	1	5	2
	X	1	1	1	3	6	4						
Labor-Intensive Manufactures (LAB66–96)	M	3	0	1	0	5	6	12	5	8	3	8	2
	X	3	2	4	0	3	5						
Capital-Intensive Manufactures (CAP61–81)	M	2	1	3	1	5	3	9	5	6	0	7	3
	X	2	1	3	1	5	6						
Machinery (MACH71–95)	M	1	4	5	1	3	2	9	4	5	0	2	1
	X	5	2	2	0	2	2						
Chemical Products (CHEM51–59)	M	4	3	7	1	7	6	12	11	17	6	12	6
	X	3	1	0	0	3	4						

Table 5B.2 Test on the Significance of Each Sectoral Regression, $F_{.05(33,47)} = 1.70$

PETRO33	30.9*	CER42	12.5*
MAT27	4.8*	LAB66	6.3*
MAT28	21.0*	LAB82	4.8*
MAT32	8.4*	LAB83	37.8*
MAT34	33.0*	LAB84	27.0*
MAT35	9.7*	LAB85	58.8*
MAT68	5.2*	LAB89	19.1*
FOR24	18.1*	LAB91	1.6*
FOR25	71.8*	LAB93	111.0*
FOR63	17.8*	LAB96	1.2
FOR64	4.1*	CAP61	35.4*
TROP5	26.9*	CAP62	30.4*
TROP6	69.0*	CAP65	7.5*
TROP7	31.3*	CAP67	26.4*
TROP17	30.3*	CAP69	9.4*
TROP23	2.0*	CAP81	5.3*
ANL0	14.6*	MACH71	18.4*
ANL1	132.1*	MACH72	12.5*
ANL2	15.9*	MACH73	19.3*
ANL3	33.1*	MACH86	12.8*
ANL21	67.0*	MACH95	3.1*
ANL29	22.9*	CHEM51	9.1*
ANL43	7.0*	CHEM52	176.5*
ANL94	40.5*	CHEM53	6.9*
CER4	3.6*	CHEM54	6.2*
CER8	1.9*	CHEM55	6.7*
CER9	5.2*	CHEM56	21.4*
CER12	7.9*	CHEM57	5.8*
CER22	4.3*	CHEM58	12.1*
CER26	13.3*	CHEM59	8.0*
CER41	2.2*		

*Test statistic significant at .05 level.

Helpman-Krugman specification contribute to the explanation of gross trade flows? The results presented in table 5B.3 indicate that in forty-nine of the sixty-one sectoral regressions, the nonlinear terms do contribute significantly to the explanation.

Notes

1. More detailed discussions of the assumptions behind the Heckscher-Ohlin results can be found in Caves and Jones (1981) and Leamer (1984).

2. The properties of Π, the GNP function, are discussed in more detail in Saxonhouse and Stern (1989).

3. The GNP function, Π_j, has been defined to allow for differentiated products and economies of scale. Following Helpman and Krugman, this can be done by including

Table 5B.3 **Test on the Significance of Each Sectoral Regression's Interaction Terms, $F_{.05} = 1.77$**
H_0: $D_{11} = D_{12} = D_{13} = \ldots = D_{56} = D_{66} = 0$

PETRO33	3.8*	CER42	1.5
MAT27	1.8	LAB66	2.3*
MAT28	4.1*	LAB82	2.7*
MAT32	1.9*	LAB83	3.3*
MAT34	0.8	LAB84	1.3
MAT35	3.4*	LAB85	3.1*
MAT68	4.7*	LAB89	8.2*
FOR24	8.0*	LAB91	0.3
FOR25	15.2*	LAB93	14.0*
FOR63	6.5*	LAB96	0.8
FOR64	2.2*	CAP61	26.1*
TROP5	1.8	CAP62	3.6*
TROP6	26.5*	CAP65	4.9*
TROP7	4.0*	CAP67	9.1*
TROP11	5.0*	CAP69	3.5*
TROP23	0.5	CAP81	2.4*
ANL0	4.1*	MACH71	4.6*
ANL1	0.5	MACH72	1.9*
ANL2	0.7	MACH73	2.3*
ANL3	3.2*	MACH86	3.4*
ANL21	12.6*	MACH95	2.7*
ANL29	0.2	CHEM51	8.4*
ANL43	1.6	CHEM52	2.2*
ANL94	11.6*	CHEM53	5.1*
CER4	1.9*	CHEM54	5.2*
CER8	2.1*	CHEM55	5.1*
CER9	1.5	CHEM56	4.0*
CER12	2.8*	CHEM57	2.3*
CER22	2.4*	CHEM58	6.0*
CER26	1.9*	CHEM59	4.9*
CER41	0.9		

*Test statistic significant at the .05 level.

optimal firm scale in Π_j. Provided optimal firm scale is small relative to market size, change in industry output can be achieved by changes in the number of firms in the industry. Firms are assumed to be identical. This means that at an industry level there will be constant returns to scale.

4. In the likely case that the number of goods exceeds the number of factors ($N > K$), trade will be indeterminant. In estimating models of this kind, Leamer (1984, p. 18) suggests that this indeterminancy can be resolved by assuming international transportation costs that deter and determine trade but are otherwise negligible. Alternatively, Saxonhouse (1983, 1986) assumes that the $N = K$ but that included and excluded dependent variables have properties such that the exclusion of relevant variables does not bias the parameters that are estimated.

It should be noted that derivation of eq. (9) does not necessarily require that the trade balance be zero or exogenously fixed at all. If securities are incorporated into a Woodland (1982) indirect trade utility function, then, with trade taking place in securities as well as goods, it is possible to use the same model to examine the influence of sectoral trade policy on both trade structure and the overall current account on international transactions. See Helpman and Razin (1978).

5. This line of reasoning was first advanced by Leontief (1956) more than thirty years ago as a possible explanation for the empirical failure of the simple Heckscher-Ohlin model.

6. The approach taken here is analogous to the two-step "jackknife" procedure proposed in Guilkey and Schmidt (1973) and Zellner (1962). As an example of the approach taken here, let $a_s = 1 + a_s'$, assuming $E(a_s') = 0$. Using instrumental variable techniques in the presence of multiplicative errors allows consistent estimates of the $R_{is} - B_{is}^+$. Using these estimates, for each economy an $NX1$ vector $[v_i]$ of the net trade residuals can be formed. Consistent estimates of the quality terms can be obtained from

$$[(R_{is} - B_{is}^+)L_s]'[(R_{is} - B_{is}^+)L_s]^{-1}[(R_{is} - B_{is}^+)L_s]'[v_i].$$

7. Following Durbin (1954), and in common with two stage least squares, the approach taken here uses synthetic instrumental variables. Factor endowments are ordered according to size and rank is used as an instrument.

8. Since the factor endowment variables in (9') explain national development, there is no need to limit the sample used here to just the most advanced economies. In general, less advanced economies impose more protection than the most advanced economies. This development-related protection is explained by changes in the levels of the factor endowments. Typically, the higher the level of factor endowments, the less the protection.

9. These same estimation techniques have been used by Saxonhouse (1983, 1986) in earlier work with multiplicative errors in variables models. Because this work used smaller and more homogeneous samples, the problems associated with using rank-order instrumental variables did not arise.

10. The proportion of zero observations for nine labor-intensive sectors was mistakenly left out of table 5.10 and is available from the author on request. The Tobit estimation methods used here for eqs. 7' and 8' are described in Greene (1981, 1983) and Chung and Goldberger (1984).

11. See, however, the discussion in Saxonhouse and Stern (1989).

12. Equation (10') has also been reestimated including Japan but successively excluding Canada, the United States, and Korea from the sample.

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Comment Laura D'Andrea Tyson

There is a wealth of anecdotal evidence not just from U.S. producers but from producers in other countries in both the developed and the developing world that there are significant barriers to market access in Japan. Whether as a result of official policies or the unofficial practices of Japanese firms—which often exhibit a definite preference for Japanese products over foreign ones, even when the latter are cheaper—foreign firms seeking to sell in Japan frequently encounter serious obstacles. These obstacles have led many in business communities both at home and abroad to conclude that the Japanese market is relatively closed compared to markets in the other advanced industrial countries.

A pattern of market closure has also been suggested by aggregate trade statistics. As Saxonhouse himself reports, by comparison with other advanced industrial countries, Japan imports a remarkably small share of the manufacturing goods it consumes. And this share has been virtually constant for decades while comparable shares have risen in most other developed market economies. It is important to note that relative market closure does not imply that the structure of Japan's trade should diverge from the structure predicted by standard comparative advantage considerations. Closure might result in less or chronically unbalanced trade but a structure of trade that reflects Japan's relatively poor resource and land endowments and its relative richness in skilled labor, capital, and technological know-how. Thus, a finding of closure is perfectly consistent with earlier empirical research by Saxonhouse indicating that Japan's pattern of trade conforms to Heckscher-Ohlin principles.

Saxonhouse's new research attempts to look at the market closure argument in an empirical framework that extends these principles to allow for intraindustry trade flows. He builds on earlier work by Lawrence, who uses a simple model of intraindustry trade in manufactured goods based on scale economies and product differentiation to examine the issue of market closure in Japan.

Lawrence's results suggest that there is something distinctive about Japan—that, in many manufactured goods, import penetration ratios are lower than levels predicted by the behavior of a sample of other industrial countries and that the gap between Japanese behavior and comparable behavior elsewhere has actually increased over time.

Saxonhouse questions these results because they are based on a methodology that explains the share of imports in total domestic use of a particular product in a particular country by that country's share of world production or

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world exports of that product. As Saxonhouse correctly notes, there is a serious simultaneity problem inherent in this methodology: export shares, import shares, and production shares are jointly determined. This poses both an estimation problem and an even more serious interpretation problem.

Even if import shares are reasonable given a country's share in global production, market-closing policies may still be a significant determinant of that country's trade behavior if such policies have affected its production share over time. And that is precisely the objective of market-closing policies based on infant-industry considerations. The question of closure is not whether imports are a relatively low share of domestic use in products, such as automobiles, in which Japan has a substantial share of global production but rather whether closure played or plays a role in the global production base in automobiles and other industries that the Japanese have built. Neither the Lawrence methodology nor the Saxonhouse methodology is equipped to answer this question.

To understand why this is so, it is necessary to clarify how market closure has influenced the evolution of Japan's competitive strength in a variety of industries. Industry studies by scholars at the Berkeley Roundtable on the International Economy (BRIE) and elsewhere indicate that temporary market closure, achieved by both formal and informal means and cooperatively supported by government and industry, has been and continues to be an important component of Japan's development strategy.[1] Protectionist measures, along with other critical elements of this strategy, such as low-cost capital, research and development and other subsidies, and preferential tax policies, have been used to promote the domestic development of industries targeted by the Japanese as critical to long-run growth and technological change. These policies have had permanent or dynamic effects so that, even after they are removed, the Japanese market remains difficult to penetrate in the targeted industries.

At different times in industries such as steel, automobiles, consumer electronics, semiconductors, computers, and sophisticated telecommunications equipment, a constellation of protectionist and promotional policies has encouraged the buildup of domestic capacity by Japanese producers seeking to compete with one another for market share in the large protected domestic Japanese market. Foreign producers who might have gained a foothold in this market on the basis of their real competitive advantage in price, quality, or some other factor have confronted a variety of barriers that have either strictly controlled or effectively precluded their access to this market.

Fostered by their infant-industry environment and responding to the availability of cheap capital and other policy incentives, Japanese firms in targeted industries have built domestic capacity and expanded production in response to the rapidly growing Japanese market. As production levels have increased, Japanese firms have realized significant scale and learning economies in their production costs, and these economies in turn have been one of the factors behind their growing competitive strength. The strong competition among Japanese firms to exploit the cost and learning advantages that accompany growing production volumes has led to the development of excess capacity for the domestic market and has fostered a competitive search for growing markets abroad. By the time this search has begun, however, the Japanese firms are in a strong enough position on the basis of the scale and learning economies they have enjoyed in the protected Japanese market to be fierce competitors on world markets against foreign firms with whom they would not have been able to compete earlier. At this point, active measures to close the Japanese market to such firms are no longer necessary—the effects of past protection are long lived and not readily reversible.

If this argument is correct, the fact that formal or informal barriers to the Japanese market in a particular industry do not exist at the moment in time does not mean that such barriers have not played an important role in the evolution of Japan's competitive strength in that industry. The history of past protection matters to current market outcomes in industries that are characterized by large economies of scale and learning economies. And such economies have been nothing short of spectacular in the industries that the Japanese have chosen to target over time.

What would Japan's trade in automobiles look like today if the Japanese domestic market had not been closed to foreign auto imports in the 1960s, when at the very least Fiat, if not General Motors, had a competitive product to offer Japanese consumers? Would the Japanese semiconductor industry have its technological and competitive edge today if not for the closure of the Japanese market to low-cost, high-quality 16k DRAMs produced by U.S. firms in the 1970s? And would Japan be at the cutting edge in fiber optics today if NTT had not orchestrated closure of the Japanese market to Corning Glass to encourage the development of a domestic production and research and development capability? These are the types of questions that must be addressed if the role of market closure in Japan is to be properly assessed.

Unfortunately, such questions cannot be answered with the model employed by Saxonhouse. This model rests on a number of assumptions that are at odds with reality in significant ways. Particularly debilitating is the fact that these assumptions are inherently static and overlook the dynamic effects of temporary closure on trade outcomes.

Saxonhouse's model assumes that consumer tastes are identical and homothetic across countries. Most of the industries that have been targeted by the Japanese have income elasticities in excess of one—as income rises, consumers both at home and abroad permanently spend a larger fraction of their incomes on such goods. The products involved are not divisible in consumption, as the model assumes—you cannot consume a little of your automobile from a Japanese source, a little from an American source, and a little from an Italian source. Most consumers must be content with at most one or two choices from the many national varieties of automobiles available. Tastes themselves are not given but are affected by what is available. If Japanese consumers had been allowed to buy Italian cars in the 1960s, they might have learned to love them. It is often alleged that Japanese consumers show a definite preference for Japanese goods, but perhaps that is because market closure has encouraged or necessitated such a preference.

Saxonhouse's model assumes that production technologies are identical across nations. But there is ample evidence that the investment and research and development spending encouraged by protectionist and promotional policies generated production innovations by Japanese firms. Aggressive competition among Japanese producers for the protected but rapidly growing domestic market resulted in real technological breakthroughs in production that are today the envy of producers around the world (Cohen and Zysman 1988). We do not know whether these breakthroughs would have occurred in the absence of closure and promotion, but we do know that a model that overlooks such breakthroughs cannot address an important factor behind Japan's competitive strength and trade performance in a variety of industries.

Finally, most of the industries that have been the targets of promotion and protection in Japan have enjoyed "large" economies of scale rather than the "small" economies of scale assumed in the Saxonhouse model. When economies of scale are large, and when distances between trading partners are great, as in the Japanese case, it is easy to imagine how a "temporary" market closure policy can have permanent effects on a country's share of world production and the share of imports in its total use of particular products.

Using the questionable assumptions of identical and homothetic tastes, identical production technologies, factor price equalization, and "small" economies of scale, Saxonhouse expands on Lawrence's model to explain each country's share of world production of particular products by the factor intensities involved in these products and the country's factor endowments. In this way, he blends a Heckscher-Ohlin explanation of production shares with the Helpman-Krugman-type model used by Lawrence, in which product differentiation and small economies of scale are important determinants of trade flows. As Saxonhouse correctly observes, under his limiting assumptions, the incorporation of scale economies—provided they are small—and product differentiation into conventional models of international trade in order to account for intraindustry trade does not invalidate the Heckscher-Ohlin interpretation of interindustry trade. But both approaches are equally ill suited to deal with the dynamic effects of market closure on national production structures and trade patterns over time.

Ultimately, Saxonhouse presents empirical estimates of a standard Heckscher-Ohlin net trade equation for interindustry trade and a derived intraindustry trade equation for gross import shares expressed as a percentage of GNP. Both equations are estimated using data for forty-one countries and sixty-one commodities.

The interindustry results are predictable and commonsensical. About half the sixty-one products are food and resource products, in which Japan tends to be at a comparative disadvantage given its relatively poor land and resource base. It should hardly be a surprise to find that Japan is a net exporter of manufactured goods and a net importer of resource-intensive products. Indeed, it is the linchpin of Japan's development strategy that Japan had to develop a competitive manufacturing base because, as the Japanese themselves point out, they could not afford to become a "second-rate agrarian power."

The intraindustry results form the core of Saxonhouse's argument. His equation explains the gross import share of each product in the GNP of each country on the basis of that country's factor endowments. As an illustration, the imports of transportation equipment as a share of GNP for each country are explained as a function of that country's factor endowments. He estimates equations of this form for each individual product. He finds that Japan's import behavior is consistent with the behavior of the other countries in his sample. In other words, in most products Japan's import- GNP ratio can be predicted by the estimates of the import-GNP ratio for the other countries in his sample, and the import-GNP ratio for most products in turn can be explained by factor endowments. Saxonhouse's results are questionable given the inappropriate assumptions and model on which they rest. But, even accepting his model for the sake of argument, there remains one serious shortcoming of his empirical results. The closure hypothesis, as usually understood, argues that Japan is relatively closed to imports of manufactured goods compared to the other advanced industrial countries. But Saxonhouse bases his estimation on a sample of countries, more than half of which are developing or newly industrializing countries and most of which have significant barriers to imports of manufactured products. Perhaps Japan's import behavior is consistent with this larger sample but still out of line with the behavior of the other advanced industrial countries. Lawrence used a smaller sample of advanced industrial countries and found that Japan's behavior differed from the behavior of these countries. It would be interesting to discover if Saxonhouse's results would hold up for Lawrence's sample of countries.

What can we conclude about the effects of market closure on Japan's pattern of trade on the basis of Saxonhouse's paper? Saxonhouse concludes that, even if such closure exists, it has had negligible effects on trade patterns for most products. But his conclusions are based on a model that is at odds in fundamental ways with the reality he is trying to explain. His model cannot be taken as an adequate test of the hypothesis that temporary market closure has had long-term effects on the competitiveness of Japanese producers in a variety of industries targeted as part of Japan's development strategy.

Note

1. The relevant case studies by BRIE scholars include Borrus, Tyson, and Zysman (1986), Stowsky (1987), and Borrus (1988). The argument that market closure has played a role in Japan's industrial policy is elaborated in greater detail in Johnson, Tyson, and Zysman (1989). Dosi, Tyson, and Zysman (1989) and Tyson and Zysman (1989) contain many of the arguments on which this review of Saxonhouse's paper rests.

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Comment Harry P. Bowen

In his paper, Gary Saxonhouse proposes to determine if the distinctiveness of Japan's trade pattern is the result of a distinctive structure of protection or if it instead reflects distinctiveness in Japan's pattern of resource supplies. As evidence of Japan's distinctive trade structure, Saxonhouse reports data indicating that Japan's import share of manufactured goods has remained remarkably low and stable between 1962 and 1985 and that Japan's share of

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intraindustry trade in manufactures is low in relation to both developing and advanced countries. As he notes, these features of Japan's trade are often cited as evidence that Japan is restrictive compared to other countries.

To examine whether Japan's trade structure reflects an unusual pattern of protection, Saxonhouse proposes to estimate equations explaining the trade in each of sixty-one "commodities" in terms of countries' resource supplies. The estimated equations are then used to predict Japan's trade pattern given its resource supplies, and those sectors in which actual trade deviates significantly from its predicted trade are identified as "restrictive."

This method of identifying departures of the trade pattern from that predicted on the basis of fundamentals is based on earlier work by Saxonhouse and others. However, a novel feature of the current analysis is that equations are developed to explain not only net trade but also exports and imports separately. Important is that these latter equations are derived from a model that admits differentiated products and economies of scale. While this is an important empirical extension of the standard trade model, an unsatisfying feature of the model is that it assumes homothetic preferences. While this assumption has a long tradition in trade analyses, recent empirical work has questioned the validity of this assumption (e.g., Hunter and Markusen 1988). Thus, it would be useful, and I think not too difficult, to extend the model to include the possibility that consumption patterns depend on income per capita as well as the level of income.

Saxonhouse's data set consists of a 1979 cross section on the trade in each of sixty-one "sectors" and the resource supplies of forty-one countries. Six explanatory variables are employed in the analysis: capital, educational attainment, labor, petroleum reserves, coal, and arable land.

Estimating first the (traditional) equations explaining net trade, Saxonhouse notes that the capital coefficient is generally positive in those sectors thought to be capital intensive but that, surprisingly, the labor coefficient is generally negative in those sectors thought to be labor intensive.

Although Saxonhouse is uncomfortable with the results for labor, I think one should not place much emphasis on this type of inference. As stated in Bowen (1983), the coefficients derived from the net trade model have no direct relation to what are usually defined as factor intensities. In particular, the coefficients are theoretically estimates of parameters that include both Rybczynski production effects and consumption effects. Thus, it appears that raising the supply of labor raises consumption relative to production in labor-intensive sectors.

Aside from concern over the "wrong" signs, Saxonhouse finds that the equations explaining net trade fit the data quite well. However, his interest is to explain not the pattern of Japan's net trade but rather the pattern of Japan's imports. In this regard, he modifies his basic import equation so that the dependent variable is the ratio of a sector's imports to GNP. Moreover, he assumes that there are multiplicative errors associated with the resource variables. These errors are thought to reflect differences in the quality of the resources across countries.

While the specification of quality differences seems appropriate for capital, labor, and land, I am less sure if it should be applied to coal and oil reserves. I have in mind the possibility of adjusting these latter variables to reflect differences in quality prior to estimation. It would require a bit more data collection, but different grades of oil can be identified, as can different grades of coal. I mention this to suggest that one may get a sense of the extent to which pure measurement error can be separated from differences in factor quality. In this regard, Saxonhouse does not present estimates of the error coefficients for coal or oil, and thus one wonders how close to unity they were.

Continuing on the issue of measurement errors, recent work by Bowen, Leamer, and Sveikauskas (1987) suggests that an additional confounding element may be present in Saxonhouse's error specification: technological differences. Thus, his estimates of the multiplicative error coefficients may include all three elements: factor quality differences, technological differences, and pure measurement errors. This confounding may help to explain the peculiar estimates he obtains for differences in labor quality across countries. It should be noted that Bowen, Leamer, and Sveikauskas also obtained peculiar estimates when the coefficients were specified to reflect only technological differences.

Despite the above remarks, Saxonhouse's intent is to predict trade patterns and not to derive estimates of factor quality. Thus, the source of the measurement error does not matter. What does matter is accounting for it, and Saxonhouse's approach is one such method.

Estimating the import model for 1979, Saxonhouse then predicts Japan's pattern of imports given its resource endowments and finds that the prediction errors in only eight of the sixty-one sectors are statistically significant. Saxonhouse concludes from this that Japan's pattern of imports is reasonably well explained by its resource patterns and that removal of barriers would be unlikely to alter Japan's pattern of trade in manufactured goods. This is a "satisfying" conclusion that is consistent with previous studies.

One question that arises from this analysis is whether the residuals for these "rogue" sectors are positive or negative. That is, were Japan's imports in these sectors lower or higher than predicted? This question seems important since his analysis initially pointed to the peculiarly *low* level of Japan's imports. Thus, in addition to testing the significance of the residuals, it would be useful to report the number of sectors for which the model predicted a higher ratio of imports to GNP.

Another issue is that the success of Saxonhouse's approach in identifying trade restrictions requires the assumptions that trade barriers are the only excluded variables and that these trade barriers are uncorrelated with resource supplies. Since trade barriers are often thought to protect certain (e.g., scarce) factors of production, the assumption of orthogonality is suspect. Of course, violating this assumption means that the explanatory variables (and not the residuals) would pick up the effects of any trade barriers. There is not much one can do about this except to note that one may be picking up only trade barriers that are uncorrelated with endowments. However, what this does suggest is that a careful examination of the residuals to detect possibly omitted resource variables is warranted. Only then can one be reasonably confident that peculiar residuals reflect barriers to trade.

Finally, the model is estimated in cross section, and the resulting estimates may have little to do with the evolution of trade patterns over time. This seems important since we would like to know if Japan is getting more or less protective relative to other countries. Thus, it may be appropriate to utilize another cross section and to estimate regressions in change form. This approach would yield the benefit of reducing additive measurement errors that are relatively constant over time and would allow one to determine if Japan's import pattern has deviated from the pattern that would be consistent with the changes in its resource supplies.

The above remarks have pointed to a number of caveats concerning the use of Saxonhouse's methodology for identifying trade barriers. However, these remarks should not overshadow the importance of the empirical specifications developed to incorporate differentiated products and economies of scale within the standard, factor supply, framework. Given this framework, it is perhaps surprising that Saxonhouse's implementation of the model dealt only with Japan's imports from the world and thus did not attempt to differentiate trade by country of origin (i.e., differentiated products). I suspect that this will be the subject of future work. I look forward to that, and other, applications of this empirical framework.

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