PUBLIC POLICY, PRIVATE PREFERENCES, AND THE JAPANESE TRADE PATTERN

Marcus Noland*

Abstract—As nontariff forms of trade protection proliferate it has become more difficult to analyze the impact of trade policy on trade flows. In a number of well-known papers researchers have attempted to infer the impact of trade policy indirectly by ascribing to trade policy the differences between actual and predicted trade flows. Much of the work has been applied to analysis of Japanese trade policy, and the conclusions of these studies have differed widely. Some previous research has also ascribed a role to the *keiretsu,* or networks of affiliated firms, in explaining Japan's apparently distinctive trade performance.

This paper presents a model that integrates data on factor endowments, observable protection in traditional and nontraditional forms, and the *keiretsu.* It extends existing research in two principal ways. First, alternative cross-national models of comparative advantage are nested to permit the identification of critical modeling assumptions underlying the divergent conclusions of the previous studies. Second, the results of the indirect method are externally validated by confronting these inferences with data on trade policy and the *keiretsu.* The results indicate that trade policy and the *keiretsu* have an important impact on Japanese trade performance.

I. Introduction

ALTHOUGH explicit barriers to trade in the form of tariffs or quotas do not appear to be high, it is alleged that imports are kept out of Japan by other, more informal, policies and practices.[1] Such practices pose very difficult problems for economists trying to assess their impact. Unlike formal border measures, internationally accepted definitions and measures of their existence do not exist, and it is unclear whether they operate by raising import prices like tariffs or by restricting import quantities like quotas. As a consequence, a veritable cottage industry of researchers has eschewed the strategy of attempting to measure the impact of these informal barriers directly, and instead has focused on inferring their impact indirectly.[2]

The usual procedure followed in this literature is to estimate econometrically a model of international trade, and then to ascribe to trade policy the differences between actual and predicted trade flows. Since this amounts to an analysis of the error terms of the regression, the robustness of the underlying estimates is of crucial significance. Perhaps not surprisingly, these studies have reached a variety of conclusions as to the distinctiveness of Japanese trade policy.

This whole line of reasoning begs another question, beyond the issue of measurement: if Japan is indeed highly protectionist, how could it be so successful? Why wouldn't protection, through traditional border measures or other less traditional practices, have the standard debilitating effects on efficiency?

One possible answer is that the presumption is wrong: Japan is not distinctively protectionist. Another is that Japan has evolved its own unique form of industrial organization, the *keiretsu,* which is both exclusionary and efficient.[3] The *keiretsu* are networks of affiliated firms. They typically may have long-standing financial, managerial, and product market links. A *keiretsu* might consist of a group of large core firms horizontally linked across markets, and the vertically linked input suppliers to the core firms, as well as, possibly, a captive distribution network.

Keiretsu are inherently exclusionary. Firms within the group receive preference to those outside; the issue is simply whether the possible efficiency gains through better information exchange, coordination, and monitoring outweigh the implicit costs of maintaining in-group preferences. Discrimination may apply equally to foreign and domestic firms outside the group.

A number of studies have examined the possible impact of *keiretsu* on Japan's trade pattern. Kreinin (1988) surveyed the capital goods procurement practices of the Australian subsidiaries of multinational firms. He found that the subsidiaries of Japanese firms used far less open procurement practices relative to the subsidiaries of non-Japanese firms, and were far more likely to purchase equipment from their home country.

Iwaki (1992) estimated a cross-country regression for a small set of manufacturing industries of imports as a share of output as a function of output, exports, and distance. He then regressed these residuals against *keiretsu* variables and found that the presence of horizontal and vertical *keiretsu* was negatively correlated with imports.

In addition, three studies examined this question econometrically in a single country, cross-industry framework,

Received for publication January 22, 1993. Revision accepted for publication May 10, 1995.

* Institute for International Economics.

I would like to thank Masahiro Kawai, Robert Lawrence, Gary Saxonhouse, seminar participants at the Far Eastern Meetings of the Econometric Society, the Korean Institute for International Economic Policy, Berkeley, Southern California, Colorado, Johns Hopkins, Claremont, Santa Cruz, George Washington, the Japan Economic Seminar, and the anonymous referees for helpful comments on an earlier draft. Peter Uimonen, Chongshan Liu, and Yuichi Takahashi provided excellent research assistance; Robert Lawrence and Kazuo Ueda kindly shared their data on *keiretsu.*

[1] These alleged barriers include administrative guidance on the part of government officials to intimidate importers, the misuse of customs procedures, and product standards, testing, and certification requirements to discourage imports; incomplete enforcement of patent and trademark rights; manipulation of government procurement procedures to the advantage of domestic suppliers; and restrictions on the distribution channels for imported products, to name a few. For additional examples and documentation see Balassa and Noland (1988), and Lincoln (1990).

[2] The best known of these studies are by Saxonhouse (1983, 1989), Bergsten and Cline (1985), Balassa (1986), Lawrence (1987), and Leamer (1988). Critical surveys of this literature can be found in Takeuchi (1989), Hamada and Srinivasan (1990), Lawrence (1993), and Saxonhouse (1993).

[3] See Aoki (1987, 1991) for descriptions of the *keiretsu.*

while another examined firm-level data.[4] The fundamental problem with these studies is that one cannot say anything sensible about the implications of Japanese practices for world welfare by examining cross-sectional data from the perspective of a single country. In particular, the models may not fully account for comparative advantage. If *keiretsu* variables are positively correlated with the missing comparative advantage variables, then the effects of the omitted varibles will be incorrectly attributed to the *keiretsu* variable.

It would thus be desirable to sort out the sources of differences among the cross-national studies and to investigate whether the existence of nontraditional trade barriers or the *keiretsu* can help explain the puzzle. This paper does this in two ways. First, alternative cross-national models of comparative advantage are nested to permit the identification of critical modeling assumptions underlying the divergent conclusions of the previous studies. Second, the results of the indirect method are externally validated by confronting these inferences with data on trade policy and the *keiretsu*.

The paper is organized as follows. In the next section a theoretical model of international trade is developed. This model is then estimated for a cross-national data set. In the succeeding section the Japanese residuals of the cross-national regressions are regressed against various measures of public policy and industrial structure. The paper concludes with some summary comments and observations.

A. *Theoretical Background*

A conventional starting point for econometric analysis of international trade flows is the Heckscher–Ohlin–Vanek model. This approach employs the standard assumptions of microeconomic trade models (factor price equalization or endowment similarity, identical homothetic preferences, etc.) to generate a reduced-form representation of a country's trade pattern based on available technology and its relative factor endowments.[5] A country's output Q is produced from a factor use matrix A and a set of endowments V:

$$Q = A^{-1}V. \tag{1}$$

World output can be described similarly:

$$Q_w = A^{-1}V_w \tag{2}$$

Under the assumption of identical homothetic utility functions and factor price equalization, each country consumes each variety of the commodities in the same proportion:

$$C = sQ_w \tag{3}$$

where s is the country's share of world output and is defined as

$$s = (Y_i - B_i)/Y_w \tag{4}$$

where Y is income and B is the trade balance evaluated at the vector of common goods prices p.

Net exports T are simply the difference between production and consumption,

$$T = Q - C \tag{5}$$

or, by back substituting,

$$T = A^{-1}V - A^{-1}sV_w$$
$$= A^{-1}(V - sV_w).$$

Unfortunately, as Leamer (1984) notes, it is ''wildly optimistic'' to expect to be able to estimate this model directly. The excess factor supplies are correlated, and a regression of trade on a subset of them is bound to lead to biased and inconsistent estimates, a problem compounded by any errors in measurement of the endowments. Instead, researchers have estimated reduced forms where data on industry net exports are regressed on national factor endowment data,

$$T_{ij} = \Sigma_k \beta_{ik} V_{kj} + u_{ij} \tag{6}$$

where

T_{ij} = net exports of commodity i by country j
V_{kj} = endowments of resource k of country j
β_{ik} = coefficients indicating the impact on net exports of commodity i of an increase in the kth endowment
u_{ij} = disturbance term.

Results obtained in previous studies suggest that the factor endowment data may be contaminated by gross measurement error. Two possible types will be considered. Multiplicative measurement error could reflect international differences in factor quality or differences in the intensity of employment of factors. (So, for example, labor might be measured with multiplicative error if either workers' intrinsic productivity varied across countries or, alternatively, hours worked varied.) Similarly, the endowment data may be subject to additive error if, for example, the services of very long-lived assets (physical infrastructure, for instance) are undercounted in capital stock estimates.

[4] Petri (1991) found that import penetration was negatively related to the share of final purchases by business and government and the degree of oligopoly in distribution. Businesses and government behaving like households implied a doubling of Japanese manufactured imports. Lawrence (1991) added variables relating to *keiretsu* affiliation to Petri's model and concluded that while vertical *keiretsu* were efficiency enhancing (reduced imports and promoted exports), horizontal *keiretsu* were not (reduced imports only). Elimination of the *keiretsu* would increase manufactured imports by $30 billion from a 1985 base. Fung (1991) found that the presence of *keiretsu* had a negative impact on the U.S.–Japan trade balance and the rest of the world's balance of trade with Japan across industries. Ueda and Nagataki (1994) regressed firm-level data on the number of employees, the capital–labor ratio, raw material inputs, and a variety of *keiretsu* measures against the import-to-sales ratio. They found no evidence that *keiretsu* act as an impediment to imports.

[5] See Leamer (1984) for a discussion of these assumptions and how they can be relaxed while preserving the linear (or at least monotone) relationship between trade and factor endowments.

The regression model in equation (6) can thus be generalized in a straightforward manner to

$$T_{ij} = \alpha + \sum_{k} \beta_{ik}(\gamma_{kj}V_{kj} + \delta_{kj}) + u_{ij} \tag{7}$$

where γ_{kj} is a multiplicative measurement error term and δ_{kj} is an additive measurement error term. This suggests a set of four nested models: model 1 in which both the multiplicative error term is set equal to 1 and the additive measurement error term is set equal to 0 (à la equation (6)); model 2 in which the multiplicative error terms (the γ_{kj}'s) are permitted to take values other than unity and the additive error terms are suppressed; model 3 where the additive error terms (the δ_{kj}'s) are estimated and the multiplicative error terms are set equal to 1; and model 4, the most general model, in which both types of error are permitted (i.e., equation (7)).

The multiplicative error terms can be estimated through instrumental variables techniques, the additive errors by observing the model in two time periods and taking first differences.[6] It is the interpretation of these parameters which is problematic. One can only discern whether unexplained variations in trade performance are due to differences in factor quality or intensity of application and protection if the two are orthogonal. If trade protection is correlated with factor intensity (and presumably it is), then the effects of protection and unusually productive factors is indistinguishable. Indeed, the estimated measurement error parameters will wipe out precisely the effects of trade policy that one is trying to detect.[7]

The model discussed thus far has been criticized on the grounds that the variable of importance is not net exports, but gross imports. This objection can be addressed through the specification of a differentiated products model, which permits the estimation of gross imports as a function of technology, relative endowments, and country size. Assume products are differentiated by country of origin. The prior assumption of identical homothetic preferences means that each country will consume identical proportions of each variety of each good. Imports consist of the home country's share of world varieties less domestically produced varieties (i.e., its share of rest-of-world production):

$$M = s(Q_w - Q) \tag{8}$$

or, by back substituting,

$$M = sA^{-1}(V_w - V).$$

Recalling that $s = (Y_i - B_i)/Y_w$, dividing both sides of equation (8) by the numerator yields an lhs expression entirely in factor endowments and world income (which is constant across countries):

$$M_i/(Y_i - B_i) = (1/Y_w)A^{-1}(V_w - V). \tag{9}$$

On this basis, an equation similar to equation (6) is estimated:

$$M_{ij}/(Y_i - B_i) = \sum_{k} \beta_{ik}V_{kj}/Y_w + u_{ij}. \tag{10}$$

Likewise a set of four nested models reflecting differing assumptions about factor endowment measurement error can be constructed: model 1 (see equation (10)) in which no measurement error is assumed; model 2 in which multiplicative error is permitted; model 3 in which additive error is permitted; and model 4 in which both types of error are permitted.

B. *Econometric Estimation*

These models have been estimated for 46 commodity categories encompassing the whole of the traded goods sector. The explanatory variables consisted of nine factor endowments (labor, physical capital, human capital, arable land, pasture land, forest land, coal, oil, and minerals), and the ratio of cost, insurance, and freight to free on board (CIF/FOB), which was used as a proxy for transport costs.[8] The country sample included 30 countries for which complete trade and endowment data sets could be constructed for the years 1968 and 1988.[9] Documentation of data sources is contained in the appendix.

[6] This is accomplished using a two-stage procedure following Saxonhouse, and Durbin (1954). First, instruments are formed by calculating the fitted values of endowments derived from a regression of their actual values on their rank orders. These instrumental variables are then regressed against the trade data by industry across countries (as in equation (6)). In the second stage, the residuals from these industry-specific regressions are stacked by country, and each country's observations are regressed (across industries) against the product of the endowments and their (industry-specific) coefficients from the first-stage regressions. The resulting coefficients are consistent estimates of the country-specific measurement error terms (γ_{kj}'s) in equation (7).

[7] If, for example, Japan protects industries that utilize arable land intensively, net exports will be higher than they otherwise would have been. Japanese land will appear internationally efficient and the multiplicative measurement error term on Japanese land will be greater than 1. In the second-stage regression, the protected industries will not appear as outliers because an adjustment has been made for the "superior quality" of Japanese arable land, whereas in reality net exports are higher than otherwise predicted because of protection. This may explain why the Saxonhouse (1983) model does not identify the Japanese rice sector as protected, although in reality there is a total import ban in this sector. This inability to distinguish between true productivity differences and the effects of protection may also help explain why Trefler (1993) estimated that Japanese crop land was more than four times as productive and pasture land was more than 104 times more productive than such land in the United States.

[8] Alternatively, one could think of locational proximity as an endowment.

[9] The countries are Argentina, Austria, Brazil, Canada, Denmark, Finland, France, Federal Republic of Germany, Greece, Hong Kong, Indonesia, Israel, Italy, Japan, Republic of Korea, Malaysia, Mexico, Norway, Pakistan, Peru, the Philippines, Singapore, Spain, Sweden, Taiwan, Thailand, Tunisia, Turkey, United Kingdom, and the United States. Some concern has been expressed that the results of this paper might be compromised by the inclusion of developing countries in the sample. To address this concern, all estimations have also been done using a subsample consisting of the 16 countries classified by the World Bank as "high-income economies." The results obtained using this subsample are quite similar to the ones reported in the paper, with one exception noted below, and are not reported for the sake of brevity.

TABLE 1.—COUNTRIES WITH STATISTICALLY SIGNIFICANT MEANS OF STUDENTIZED RESIDUALS

Dependent Variable	Model 1 ($\gamma = 1$, $\delta = 0$)	Model 2 ($\delta = 0$)	Model 3 ($\gamma = 1$)	Model 4 (No Restrictions)
Net exports	None	None	None	None
Scaled imports	Hong Kong (+)[a] Singapore (+)[a]	Hong Kong (+)[a] Singapore (+)[a]	Hong Kong (+)[a] Singapore (+)[a]	None
Unscaled imports	Indonesia (−)[b]	Argentina (−)[b] France (+)[b] Germany (+)[b] Japan (+)[a] U.K. (+)[b]	Japan (−)[a]	France (+)[b] Germany (+)[b] Italy (+)[a] Japan (+)[a] Peru (+)[c] Sweden (−)[a]

Notes: Means of studentized t's distributed with 45 degrees of freedom. Sign of mean in parentheses.
[a] Significant at the 1% level.
[b] Significant at the 5% level.
[c] Significant at the 10% level.

TABLE 2.—ESTIMATED MULTIPLICATIVE MEASUREMENT ERROR TERMS, JAPAN

Endowment	Net Exports Model 2	Net Exports Model 4	Scaled Imports Model 2	Scaled Imports Model 4	Unscaled Imports Model 2	Unscaled Imports Model 4
Labor	0.88	0.72	0.06	1.53	0.77	2.01
Capital stock	0.86	0.56	−0.01	0.01	1.04	0.63
Human capital	0.98	0.58	−0.08	−0.14	0.95	0.74
Arable land	−1.04	12.70	1.14	26.28	−1.32	22.94
Pasture land	−0.39	−0.21	1.43	5.66	0.58	2.16
Forest	2.26	137.85	0.35	524.34	4.27	573.24
Coal	0.63	2.39	0.75	1.96	−0.86	2.68
CIF/FOB	0.20	2.04	−0.01	0.15	0.19	2.19
Minerals	4.00	−4.70	0.95	−4.29	6.93	−3.65
Oil	13.74	−28.54	−79.55	113.88	−99.74	−188.85

Lagrange multiplier tests (Breusch and Pagan, 1979) were used to test for heteroskedasticity. Where concern was warranted, White's heteroskedastic-consistent covariance matrix estimator was used, otherwise ordinary least-squares estimates are reported (White, 1980).[10] Summaries of the estimates of the net export and import models are available upon request. The F-test that the explanatory variables are jointly equal to zero could be rejected at the 5% level of significance in all (368) cases.

Studentized residuals were calculated for each observation, and for each regression specification the mean of each country's studentized residual was calculated.[11] A significant positive (negative) value of this statistic would imply that a country maintained higher (lower) net exports than the regression model would predict, with an analogous interpretation in the case of the import regressions.

Table 1 lists the countries with significant means for the net export and import models. No significant values of the means statistic were obtained in the net export regressions. For the import regressions, five of 120 observations were significant at the 5% level or higher. They were Hong Kong, positive (i.e., higher than expected imports), models 1, 2, and 3; and Singapore, positive, models 1 and 2. Since the city states were clearly outliers, the model was reestimated excluding these observations, and then reestimated on high-income countries only. In each case the smallest economies in the sample were outliers, with higher than expected import shares.

This suggests that the specification in equation (10) does not adequately capture the nonlinear relationship between national income and trade openness. In response the regressions were reestimated with unscaled imports replacing scaled imports as the dependent variable. In this case a number of countries have significant means of their studentized residuals, and the alternative specifications do not yield consistent results, at least in the case of Japan.

One way of distinguishing model reliability would be to examine the estimates of the error terms for the multiplicative error models 2 and 4. If what is truly being estimated are multiplicative measurement errors due to differences in endowment quality or intensity of usage, one would expect these estimates to be strictly positive and to cluster around 1.0.

The estimates for Japan are reported in table 2. They are rather implausible. It should be noted that however unbelievable these estimates are, equally bizarre results were obtained in previous attempts to estimate endogenous multiplicative measurement error terms by Bowen et al. (1987) and Saxonhouse (1989). Sadly it appears that our ability to estimate such factor productivity differences remains quite primitive.[12]

In summary, if the scaled import model is rejected on the basis of misspecification, and models 2 and 4 are rejected due to the implausibility of the quality-adjustment terms, then Japan and Indonesia are the only countries for which a mean studentized residual statistic remains significant—with the Japanese negative value obtained in import model

[10] In theory, the dependent variable of the import equation may be truncated at zero, raising a well-known set of estimation problems. However, in the data set at hand, there was only one observation out of 1380 that was actually zero, thus mooting this problem.

[11] The studentized residual of observation j, e_j^*, is defined as $e_j^* = e_j/[s(j)(1 - h_j)^{1/2}]$, where e_j is the residual from the original regression, $s(j)$ is the estimated standard error of the residual from a regression where the jth row of the matrix of explanatory variables X and the vector of dependent variables Y have been deleted, and $h_j = x_j(X'X)^{-1}x_j$, where x_j is the jth row vector from the X matrix. The studentized residual has an interesting interpretation, since it can be shown that it is the t-value one would obtain for a dummy variable taking the value 1 for the jth observation and 0 otherwise in the original regression (Belsley et al. (1980)).

[12] In a paper of related interest, Trefler (1993) calculated the productivity differences that would be necessary for the HOV relationship to hold exactly (using the U.S. input–output table for the matrix A). His results, though quite interesting, appear similarly unconvincing in the case of Japan: the implied ratios of Japanese to U.S. productivity are for professional and technical labor (1.17), administrative and managerial labor (1.48), clerical labor (0.70), sales labor (0.44), service labor (1.01), agricultural labor (0.06), production and transport labor (0.61); for crop land the implied productivity ratio is (4.59), and for pasture land it is (104.33).

TABLE 3.—NET EXPORT REGRESSIONS

Dependent Variable	Independent Variables											
	Constant	Tariffs	TARQUOTA	QUOTAS	S&PREG	STATTRAD	VERIN	VEROUT	STNDS	HKEI	VKEI	R^2
Model 1 ($\gamma = 1, \delta = 0$)	1.75	−0.71	14.64	—	−0.45	−2.78	—	−1.77	−1.72	2.57	3.88	0.58
(Dodwell Marketing)	(1.28)	(−2.63)[a]	(2.26)[b]		(−0.77)	(−2.98)[a]		(−3.36)[a]	(−1.59)	(1.89)[c]	(1.74)[c]	
Model 3 ($\gamma = 1$) (Dodwell	4.33	−0.86	18.74	—	−1.59	2.44	—	−2.07	−5.59	0.09	6.94	0.45
Marketing)	(1.81)[c]	(−1.93)[c]	(1.82)[c]		(−1.59)	(2.24)[b]		(−2.14)[b]	(−4.49)[a]	(1.20)	(2.33)[b]	
Model 1 ($\gamma = 1, \delta = 0$)	3.25	−0.85	—	—	−0.42	−3.35	7.77	−1.87	−0.40	1.46	1.72	0.57
(Toyo-Keizai)	(2.80)[a]	(−2.60)[a]			(−0.74)	(−3.86)[a]	(2.18)[b]	(−3.18)[a]	(−0.44)	(1.83)[c]	(1.48)	
Model 3 ($\gamma = 1$) (Toyo-	5.89	−1.60	—	—	−2.87	1.04	19.02	−3.23	−2.31	5.19	5.48	0.59
Keizai)	(3.39)[a]	(−3.16)[a]			(−2.05)[b]	(0.65)	(3.38)[a]	(−3.80)[a]	(−1.98)[c]	(6.19)[a]	(2.72)[a]	
Model 1 ($\gamma = 1, \delta = 0$)	2.53	−0.68	—	0.42	0.52	−4.43	6.29	−1.87	—	1.04	1.31	0.55
(Keizai-Chousa-Kyoukai)	(2.82)[a]	(−3.32)[a]		(0.62)	(0.70)	(−7.33)[a]	(2.48)[b]	(−2.81)[a]		(1.02)	(1.21)	
Model 3 ($\gamma = 1$) (Keizai-	3.67	−1.16	—	1.25	−0.51	−2.70	15.88	−3.64	—	4.73	4.46	0.54
Chousa-Kyoukai)	(3.53)[a]	(−3.34)[a]		(1.18)	(−0.40)	(−2.17)[b]	(3.49)[a]	(−3.92)[a]		(3.03)[a]	(2.52)[b]	

Notes: *t*-statistics are in parentheses. There are some observations missing for each of the *keiretsu* variables, though the missing observations are not the same for each definition. (The Dodwell Marketing results are based on a sample of 29 usable data points, the Toyo-Keizai sample is 25 usable observations, and the Keizai-Chousa-Kyoukai sample size is 26.) Consequently, some of the binary nontariff barrier variables do not take both values for some data sets, such as tariff quotas, in the Toyo-Keizai and Keizai-Chousa-Kyoukai samples.

[a] Significant at the 1% level.

[b] Significant at the 5% level.

[c] Significant at the 10% level.

3, the more general of the two remaining specifications, the only mean significant at the 1% level.[13]

C. *Public Policy and Private Preferences*

The regressions reported thus far have controlled for the influence of factor endowments on the pattern of comparative advantage. The studentized residuals thus represent the deviations of actual from predicted trade flows, which cannot be explained by these factors. If trade policies and industrial structure have a significant impact on the cross-commodity composition of trade, then variables relating to trade policy and the industrial structure should be correlated with the studentized residuals.[14] In particular, if trade policies and the *keiretsu* restrict imports, then these variables should be positively correlated with the studentized residuals from the net export equations (since imports are being reduced, thus boosting net exports), while they should be negatively correlated with the studentized residuals from the import equations.

Data on tariffs and nontariff barriers have been compiled on the basis of the General Agreement on Tariffs and Trade (GATT) (1990). A set of binary variables were constructed for nontariff barriers, indicating whether a particular policy was present in each sector. The policies covered were quotas; tariff-quotas (TARQUOTA); sanitary and phytosanitary regulations (S&PREG); production and/or price controls (the two policies were perfectly collinear); state trading (STATTRAD); discriminatory internal taxation; health and safety regulations; prior confirmation, notification, or approval requirements; voluntary export restraints applied to imports (VERIN); voluntary export restraints applied to exports (VEROUT); discriminatory standards, testing, and certification requirements (STNDS); and direct subsidies (ASST). This list, while not comprehensive (it omits administrative guidance, for instance), nonetheless includes many, if not most, informal barriers. Presumably these variables would be highly correlated with any omitted variables if the government acted in a rational, or at least consistent, way.

This leaves the *keiretsu.* Membership in *keiretsu* is not always well defined owing to the multiple linkages (product, factor, distribution) that affiliated firms may manifest. Consequently, results using three different sources of data on industry sales shares accounted for by horizontal (HKEI) and vertical (VKEI) *keiretsu* (Dodwell Marketing Consultants (1986), Toyo-Keizai (1994), and Keizai-Chousa-Kyoukai (1993)) are reported as an informal check on robustness.[15]

The Japanese studentized residuals (from the nonrejected models 1 and 3) were regressed against these indicators to test whether indirect inferences derived from the trade equations could be confirmed through external validation. These regressions are reported in table 3 for net exports, table 4 for scaled imports, and table 5 for unscaled imports.

[13] Another way of scaling the importance of the outlying observations would be in terms of their importance in consumption, production, or trade. So for example, the sectors with studentized residuals less than −2.0 for Japan in the unscaled import model 3 account for 42.4% of Japanese imports. (The other extreme is given by the scaled import model 1, where there are no outlying Japanese observations.)

[14] Of course if the comparative advantage regressions were misspecified (by omitting a relevant variable, for instance) and the public policy and *keiretsu* variables were correlated with the source of the misspecification, then the results of misspecification would be incorrectly attributed to the public policy and *keiretsu* variables.

[15] Lawrence (1991) compiled data from Dodwell Marketing Consultants (1986) on the extent of *keiretsu* participation in Japanese manufacturing. For the Dodwell data, the variable HKEI is the share of industry sales by eight major horizontal *keiretsu;* VKEI is the share of nine major vertical *keiretsu* in industry sales. Ueda and Nagataki began with data on firms listed on the Tokyo and Osaka stock exchanges. The *keiretsu* status of these firms was then assigned according to information in Toyo-Keizai (1994) and, alternatively, Keizai-Chousa-Kyoukai (1993). The firm-level data were then aggregated up to the industry classification used in this paper. Some large firms produce products in several industries, and their sales were allocated across industries using sales data in Toyo-Keizai (1994).

TABLE 4.—SCALED IMPORT REGRESSIONS

Dependent Variable	Independent Variables												
	Constant	Tariffs	TARQUOTA	QUOTAS	S&PREG	STATTRAD	VERIN	VEROUT	STNDS	ASST	HKEI	VKEI	R^2
Model 1 (γ = 1, δ = 0) (Dodwell Marketing)	0.45 (3.52)[a]	−0.06 (−2.27)[b]	1.33 (1.98)[b]	—	−0.51 (−3.21)[a]	0.66 (2.73)[a]	—	0.04 (0.41)	0.27 (1.37)	0.10 (0.92)	−0.29 (−1.40)	−0.54 (−3.01)[a]	0.55
Model 3 (γ = 1) (Dodwell Marketing)	−0.09 (−0.39)	0.00 (0.02)	−0.45 (−0.35)	—	0.12 (0.79)	−1.77 (−5.71)[a]	—	−0.57 (−3.03)[a]	1.65 (5.07)[a]	−2.19 (−6.85)[a]	0.19 (0.62)	−1.16 (−2.46)[b]	0.77
Model 1 (γ = 1, δ = 0) (Toyo-Keizai)	0.31 (3.43)[a]	−0.08 (−2.03)[b]		—	−0.64 (−5.05)[a]	0.87 (4.00)[a]	0.76 (1.69)[c]	0.04 (0.34)	0.27 (1.37)	0.08 (0.80)	−0.31 (−2.27)[b]	0.20 (1.20)	0.56
Model 3 (γ = 1) (Toyo-Keizai)	−0.22 (−0.88)	0.04 (0.52)		—	0.28 (1.90)[c]	−1.28 (3.84)[a]	−0.08 (−0.10)	−0.41 (−2.48)[b]	1.04 (3.22)[a]	−2.03 (−5.96)[a]	−0.32 (−1.62)	0.00 (0.00)	0.72
Model 1 (γ = 1, δ = 0) (Keizai-Chousa-Kyoukai)	0.22 (1.72)[c]	−0.01 (−0.17)	—	−0.12 (−0.93)	−0.43 (−2.17)[b]	0.68 (3.40)[a]	−0.11 (−0.23)	0.07 (0.65)	—	0.22 (2.23)[b]	−0.42 (−3.00)[a]	−0.05 (−0.26)	0.38
Model 3 (γ = 1) (Keizai-Chousa-Kyoukai)	0.13 (0.41)	0.03 (0.46)	—	−0.37 (−1.62)	0.21 (1.02)	−0.47 (−2.92)[a]	−0.60 (−0.68)	−0.16 (−0.69)	—	−1.73 (−3.48)[a]	−0.59 (−1.67)[c]	−0.36 (−1.52)	0.62

Notes: *t*-statistics are in parentheses. There are some observations missing for each of the *keiretsu* variables, though the missing observations are not the same for each definition. (The Dodwell Marketing results are based on a sample of 29 usable data points, the Toyo-Keizai sample is 25 usable observations, and the Keizai-Chousa-Kyoukai sample size is 26.) Consequently, some of the binary nontariff barrier variables do not take both values for some data sets, such as tariff quotas, in the Toyo-Keizai and Keizai-Chousa-Kyoukai samples.

[a] Significant at the 1% level.
[b] Significant at the 5% level.
[c] Significant at the 10% level.

TABLE 5.—UNSCALED IMPORT REGRESSIONS

Dependent Variable	Independent Variables											
	Constant	Tariffs	TARQUOTA	QUOTAS	S&PREG	STATTRAD	VERIN	VEROUT	STNDS	HKEI	VKEI	R^2
Model 1 (γ = 1, δ = 0) (Dodwell Marketing)	−1.50 (−2.71)[a]	0.12 (1.00)	−3.75 (−1.21)	—	0.31 (0.72)	−0.77 (−1.01)	—	−0.61 (−1.79)[c]	1.50 (2.03)[b]	−2.69 (−2.91)[a]	−0.41 (−0.36)	0.49
Model 3 (γ = 1) (Dodwell Marketing)	−6.55 (−5.60)[a]	0.43 (1.60)	−10.22 (−1.50)	—	−0.77 (−1.06)	−5.41 (−3.93)[a]	—	1.82 (1.39)	6.90 (4.46)[a]	−1.99 (1.13)	1.17 (0.53)	0.72
Model 1 (γ = 1, δ = 0) (Toyo-Keizai)	−2.36 (−5.28)[a]	−0.08 (−0.58)	—	—	−0.10 (−0.24)	−1.12 (−1.39)	3.83 (2.29)[b]	−0.91 (−2.61)[a]	1.83 (2.53)[b]	1.02 (1.98)[c]	0.20 (0.30)	0.45
Model 3 (γ = 1) (Toyo-Keizai)	−7.13 (−9.27)[a]	0.34 (1.07)	—	—	−0.77 (−1.24)	−6.68 (−5.83)[a]	−2.08 (−0.54)	1.95 (1.75)[c]	7.83 (7.32)[a]	−0.18 (0.81)	−1.71 (−1.15)	0.77
Model 1 (γ = 1, δ = 0) (Keizai-Chousa-Kyoukai)	−2.02 (−3.21)[a]	0.09 (0.55)	—	−0.74 (−1.69)[c]	0.30 (0.36)	−0.24 (−0.32)	0.37 (0.18)	−0.10 (−0.21)	—	−0.77 (−0.64)	−1.19 (−1.59)	0.27
Model 3 (γ = 1) (Keizai-Chousai-Kyoukai)	−5.06 (−3.19)[a]	0.33 (0.86)	—	−1.02 (−0.91)	−0.30 (−0.19)	−0.85 (−0.61)	−7.04 (−1.42)	4.97 (2.99)[a]	—	−3.54 (−1.54)	−5.14 (−2.56)[b]	0.45

Notes: *t*-statistics are in parentheses. There are some observations missing for each of the *keiretsu* variables, though the missing observations are not the same for each definition. (The Dodwell Marketing results are based on a sample of 29 usable data points, the Toyo-Keizai sample is 25 usable observations, and the Keizai-Chousa-Kyoukai sample size is 26.) Consequently, some of the binary nontariff barrier variables do not take both values for some data sets, such as tariff quotas, in the Toyo-Keizai and Keizai-Chousa-Kyoukai samples.

[a] Significant at the 1% level.
[b] Significant at the 5% level.
[c] Significant at the 10% level.

The results reported for each *keiretsu* classification system are generally quite similar. In four of the six net export regressions, both the horizontal (HKEI) and the vertical (VKEI) *keiretsu* variables are positive and significant (at least once for each model and *keiretsu* classification), indicating that the presence of *keiretsu* is positively associated with net exports, once comparative advantage is taken into account.

Tariffs are negatively associated with net exports in all six cases, however. This is unexpected as tariffs, by suppressing imports, would raise net exports.[16] There are at least two possible explanations for this. First, if products are differentiated, tariffs will increase the demand for home goods and discourage exports.

Second, the tendency of studentized residuals in the net export as well as import equations to be negative, and the significant negative correlation between some of the more obvious trade policy variables and studentized residuals from the net export equations suggest an alternative interpretation. During the 1970s and 1980s Japan was increasingly the target of discriminatory protection by its trade partners.

[16] It has been suggested that tariffs might be replaced with effective rates of protection (ERPs). One problem is that existing ERPs for Japan (e.g., Shouda, 1982) do not take quantitative restrictions into account and are subject to some serious measurement error problems. In any event, the results obtained using ERPs are similar to those in tables 3 to 5, and are not reported for the sake of brevity.

If one assumes that as a first approximation the aggregate trade balance is predetermined by domestic saving and investment decisions, then the imposition of trade barriers by a country's trade partners may depress both imports and exports. If these effects were large, one would observe negative studentized residuals for both exports and imports. If this effect was large enough, it might overwhelm the influence of relatively mild domestic policy interventions on trade flows, giving rise to insignificant or even perversely signed coefficients on domestic policy variables.

Indeed, VERs applied against Japanese exports (VEROUT) significantly reduced net exports in all six cases, lending credence to this possibility. VERs applied against imports significantly increased net exports in the four regressions where the variable was defined in table 3. Similarly, tariff quotas (TARQUOTA) were found to increase net exports.

While these variables took their expected signs, several others did not. The state trading variable (STATTRAD) was negative and significant in five of six cases, as were the sanitary regulation (S&PREG) (in one case) and the technical standards (STNDS) nontariff barrier variables (in two cases).

The scaled and unscaled import regressions are reported in tables 4 and 5, respectively. In seven cases the *keiretsu* are negative and significant, indicating that the presence of the *keiretsu* are associated with lower than expected imports once comparative advantage is taken into account. However, in one case in table 5 the coefficient has an unexpected positive sign.

In contrast to the net export regressions, the tariff coefficients either have the expected negative sign, or else are statistically insignificant.[17] Likewise, the quota variable is negative and significant as expected in one case, and insignificant otherwise. The results for the other nontariff barrier variables are less robust.

In summary, in 15 out of 16 cases, the *keiretsu* variables are associated with either higher than expected net exports or lower than expected imports. The tariff variable is expectedly associated with higher than expected net exports in a number of cases, though the variable takes the expected negative sign in the import regressions when it is significant. The quota, tariff quota, sanitary and phytosanitary regulation, voluntary export restraints, and subsidy variables generally take their expected signs. The dummies for state trading and technical standards take unexpected signs more often than not.

Conclusions

This paper has extended previous research in two ways: first, by nesting alternative cross-national models of comparative advantage to identify the possible sources of the divergent conclusions reached by previous studies, and second, by externally validating the results of the indirect approach by confronting these results with actual data on trade policies and the *keiretsu.*

To address the first of these issues, models of multiplicative and additive measurement error were estimated. The estimates of multiplicative error terms were implausible, as in previous attempts to estimate endogenous factor quality terms. From a practical perspective, the possibility of additive measurement errors was largely irrelevant, as the models permitting and excluding this possibility yielded very similar results.

With regard to Japan, the results of the factor endowment regressions yielded some weak evidence that Japan was an outlier with respect to trade behavior. Japan was one of only two countries for which the mean of its studentized residuals was significantly different from zero in any of the acceptable models. This occurred in import model 3, where the mean of the Japanese studentized residuals was negative and significantly different from zero at the 1% level.

These residuals were then regressed against policy variables to see whether the pattern of residuals was consistent with information about Japanese trade policy and the *keiretsu.* The *keiretsu* variables are generally associated with higher than expected net exports and lower than expected imports. The results for the trade policy variables were less robust. There is some reason to believe that the unexpected results for the domestic policy variables may be related to the imposition of VERs on Japanese exports by Japan's trade partners.

This leaves obvious paths for future research. First, it would be highly desirable to improve our analysis of cross-country productivity differences. Second, it would be desirable to improve the quality of data on nontariff barriers.

Lastly, this study (and others) have treated the *keiretsu* as an exogenous variable. As the evidence mounts that the *keiretsu* have an appreciable impact on Japanese economic performance, it may be worthwhile to endogenize the *keiretsu* as a response to underlying capital and product market structures as well as production technology.

[17] This reinforces the notion that the perverse results obtained on the tariff variable in the net export regressions may be due to the impact of tariffs on export, not import, behavior.

REFERENCES

Aoki, Masahiko, "The Japanese Firm in Transition," in Kozo Yamamura and Yasukichi Yasuba (eds.), *The Political Economy of Japan, Vol. 1: The Domestic Transformation* (Stanford: Stanford University Press, 1987).

——— "The Japanese Firm as a System: Survey and Research Agenda," presented at the Japan Economic Seminar, New York (Nov. 16, 1991).

Balassa, Bela, "Japan's Trade Policies," *Weltwirtschaftliches Archiv* 122 (1986), 745–790.

Balassa, Bela, and Marcus Noland, *Japan in the World Economy,* (Washington, DC: Institute for International Economics, 1988).

Belsley, David A., Edwin Kuh, and Roy E. Welsch, *Regression Diagnostics* (New York: Wiley, 1980).

Bergsten, C. Fred, and William R. Cline, "The United States–Japan Economic Problem," in *Policy Analyses in International Economics* 13 (Washington, DC: Institute for International Economics, 1985).

Bowen, Harry P., Edward E. Leamer, and Leo Sveikauskas, ‘‘Multicountry, Multifactor Tests of the Factor Abundance Theory,’’ *American Economic Review* 77:5 (1987), 791–809.

Breusch, T. S., and A. R. Pagan, ‘‘A Simple Test for Heteroskedasticity and Random Coefficient Variation,’’ *Econometrica* 47 (1979), 1287–1294.

Dodwell Marketing Consultants, *Industrial Groupings in Japan* (Tokyo: Dodwell Marketing Consultants, 1986).

Durbin, J., ‘‘Errors in Variables,’’ *Review of the International Statistical Institute* 22 (1954).

Fung, K. C., ‘‘Characteristics of Japanese Industrial Groups and Their Potential Impact on U.S.–Japan Trade,’’ in Robert Baldwin (ed.), *Empirical Studies of Commercial Policy* (Chicago: University of Chicago Press, 1991).

General Agreement on Tariffs and Trade (GATT), *Trade Policy Review* (Japan, Geneva, 1990).

Hamada, Koichi, and T. N. Srinivasan, ‘‘The U.S.–Japan Trade Problem,’’ presented at the Japan Economic Seminar, Columbia University, New York (Apr. 20, 1990).

Iwaki, Hidehiro, ‘‘Market Mechanisms in Japan (I),’’ prepared for the Tokyo Club Meeting (Yokohama, Sept. 28–29, 1992).

Keizai-Chousa-Kyoukai, *Nenpou-Keiretsu-no-Kenkyuu* (1993).

Kreinin, Mordechai E., ‘‘How Closed Is Japan’s Market?’’ *World Economy* 7 (1988), 529–541.

Lawrence, Robert Z., ‘‘Imports to Japan: Closed Markets or Closed Minds?’’ *Brookings Papers on Economic Activity* 2 (1987), 517–554.

——— ‘‘Efficient or Exclusionist? The Import Behavior of Japanese Corporate Groups,’’ *Brookings Papers on Economic Activity* 1 (1991), 311–341.

——— ‘‘Japan’s Different Trade Regime: An Analysis with Particular Reference to *Keiretsu*,’’ *Journal of Economic Perspectives* 7:3 (1993), 3–19.

Leamer, Edward E., *Sources of International Comparative Advantage* (Cambridge: MIT Press, 1984).

——— ‘‘Measures of Openness,’’ in Robert Baldwin (ed.), *Trade Policy Issues and Empirical Analysis* (Chicago: University of Chicago Press, 1988), 147–200.

Lincoln, Edward J., *Japan’s Unequal Trade* (Washington, DC: Brookings Institution, 1990).

Petri, Peter A., ‘‘Japanese Trade in Transition: Hypotheses and Recent Evidence,’’ in Paul R. Krugman (ed.), *Trade with Japan* (Chicago: University of Chicago Press, 1991).

Saxonhouse, Gary R., ‘‘The Micro- and Macro-Economics of Foreign Sales to Japan,’’ in William R. Cline (ed.), *Trade Policies in the 1980s* (Washington, DC: Institute for International Economics, 1983), 259–304.

——— ‘‘Differentiated Products, Economies of Scale, and Access to the Japanese Market,’’ in Robert C. Feenstra (ed.), *Trade Policies and International Competitiveness* (Cambridge: National Bureau of Economic Research, 1989).

——— ‘‘What Does Japanese Trade Structure Tell Us about Japanese Trade Policy,’’ *Journal of Economic Perspectives* 7:3 (1993), 21–43.

Shouda, Yasutoyo, ‘‘Effective Rates of Protection in Japan,’’ *Nihon Keizai Kenkyu* 11 (Mar. 1982), 68–70.

Takeuchi, Kenji, ‘‘Does Japan Import Less Than It Should? A Review of the Econometric Literature,’’ *Asian Economic Journal* 3:2 (1989), 138–170.

Toyo-Keizai, *Kigyo Keiretsu Sokan* (Tokyo: Toyo-Keizai Shinposha, 1994).

Trefler, David, ‘‘International Factor Price Differences: Leontieff Was Right!’’ *Journal of Political Economy* 101:6 (1993), 961–987.

Ueda, Kazuo, and Yuri Nagataki, ‘‘The Import Behavior of Japanese Corporate Groups: Evidence from Micro Survey Data,’’ University of Tokyo, Mimeo (Nov., 1994).

White, Halbert, ‘‘A Heteroscedastic-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity,’’ *Econometrica* 44:4 (1980), 817–838.

APPENDIX

The trade data originate from the GATT tapes. The labor endowment was defined as the economically active population; the data come from International Labour Organisation (ILO), *Yearbook of Labour Statistics,* various issues. The capital stock was calculated by summing and depreciating the purchasing-power-adjusted gross fixed investment series found in Robert Summers and Alan Heston, ‘‘The Penn World Tables (Mark 5),’’ *Quarterly Journal of Economics,* May 1991. The asset life of capital was assumed to be 18 years and the depreciation rate 13%.

Human capital was calculated by multiplying the economically active labor force by the Psacharopoulos index of per-capita educational capital. The Psacharopoulos index is defined as the average per-capita expenditure on education embodied in the labor force calculated from data on the highest level of educational achievement, years duration of schooling at each level, and expenditures per year at each level normalized by the amount of expenditure for one year of primary school education. Data on educational achievement and schooling duration are found in the United Nations Educational Social and Cultural Organisation (UNESCO), *Statistical Yearbook.* Expenditure weights come from George Psacharopoulos, *Returns to Education,* Jossey-Bass, San Francisco, 1973.

Data on land endowments come from the Food and Agricultural Organisation (FAO), *Production Yearbook.*

The coal endowment was measured by domestic production in thousands of metric tons and comes from the U.S. Bureau of Mines, *Minerals Yearbook.* (Data on coal mining capacity or reserves were unavailable for most countries.) The minerals index is the value of domestic production of 13 minerals; the production data are from the *Minerals Yearbook,* the price data are from the IFS. (The composition of this index was determined by taking the top 20 minerals [excluding oil, natural gas, and coal] by value of world output in 1984 and then dropping those for which price data could not be found.) The oil endowment in proven reserves was taken from the *Oil and Gas Yearbook,* published by the American Petroleum Institute.

Lastly, the CIF/FOB data come from the IMF, *IFS Trade Supplement.*

In some cases, data for Taiwan were unavailable from these sources, and instead come from *Taiwan Statistical Data Book,* Council for Economic Planning and Development, Executive Yuan, Republic of China.

Data on Japanese trade policies come from the GATT, *Trade Policy Review Japan,* Geneva, November 1990.