Journal of Agricultural and Resource Economics 23(2):338–350
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Trade Liberalization and Japanese Agricultural Import Policies

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This analysis empirically evaluates a subset of Japanese agricultural policies during the 1970s and 1980s using the Trade Restrictiveness Index recently developed by Anderson and Neary. This index, though theoretically rigorous, is empirically demanding, resulting in relatively few applications. Inferences obtained from the index are in general accordance with policy changes and economic events over the period of analysis. Using 1970 as the base, the estimated TRI suggests that policy changes during 1970–87 resulted in moderately liberalized trade. Comparison with a conventional measure of trade distortion—producer and consumer subsidy equivalents (PSEs and CSEs)—reveals contrasting inference. This suggests the choice of empirical measures in evaluating trade policies is nontrivial.

Key words: Japanese agriculture, liberalization, protection, trade policy

Introduction

The successful conclusion of the Uruguay Round of the GATT, in conjunction with the recent proliferation of bilateral and regional trade agreements, has in large part come about because of the historically unparalled global agreement as to the desirability of *trade liberalization.* While the benefits of liberalized trade are generally acknowledged, precisely how to measure the degree to which changes in complex policy regimes reflect liberalized trading environments represents an important and difficult challenge to empirical economics. The difficulty in measuring the rate of trade liberalization derives from the fact that trade-distorting policies take many forms, including tariffs, quotas, and certain domestic policies, as well as a plethora of nontariff barriers. Thus one must aggregate across heterogeneous policy instruments.

Numerous measures for determining the degree to which trade policy regimes are protective have been put forward.[1] Notable among these are the average tariff (Haberler), nominal and effective rate of protection (Corden 1966, 1971), domestic resource cost (Bruno), and producer/consumer subsidy equivalents (United Nations/Food and Agriculture Organization). While each of these measures captures changes in some trade-distorting policies, a single unified measure that adequately accounts for a wide range of policy instruments has remained elusive.

In a recent series of papers, Anderson; Anderson and Neary (1994); and Anderson, Bannister, and Neary have proposed the Trade Restrictiveness Index (TRI) as a

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[1] Intuitively, the degree to which trade liberalization occurs may be captured by changes in the level of protection associated with a country's trade policy regime.

theoretically rigorous measure of the degree to which changes in trade policy regimes reflect a liberalized trading environment. The TRI directly approaches the measurement of trade policy changes as a problem of aggregation across heterogeneous policies using the balance-of-trade function. This approach, which is somewhat analogous to the true-cost-of-living index problem, provides appropriate weights for use in aggregating various policy instruments (e.g., tariffs, quotas, etc.).

Though the TRI provides a rigorous theoretical measure for assessing the degree to which policy changes reflect trade liberalization, empirical estimation of the TRI is computationally demanding. Indeed, relatively few empirical applications of the TRI can be found in the literature (Anderson and Neary 1994; Anderson, Bannister, and Neary). The purpose of this study is to mitigate this paucity of empirical literature on the TRI in two ways. First, a TRI index is estimated for a subset of Japanese agricultural products over the 1970–87 period, and then evaluated against historical trade policy changes and other relevant economic events. While such analysis of the index is admittedly qualitative, it does provide some insight into the degree to which this empirical measure conforms with economic intuition surrounding historical trade policy changes. Second, the estimated index is compared with a competing measure of trade distortion. Such comparison is again admittedly qualitative. However, it does give some indication of the degree to which the added computational burden associated with the TRI matters.

The remainder of the article proceeds as follows. First, we offer an overview of the TRI and its theoretical foundation, followed by a description of the methodology used in empirically estimating the index for a set of Japanese agricultural products. The next section presents the empirical results of the analysis and evaluates the resulting estimates against known historical policy changes and economic events, as well as providing a comparison with competing measures. Conclusions are presented in the final section.

The Trade Restrictiveness Index

The Trade Restrictiveness Index is perhaps best understood via comparison with compensating variation measures and price indexes. For an arbitrary change in the price vector (**p**) which moves the consumer from an initial utility (u^0) to a final utility (u^1), the compensating variation is defined as the income adjustment, evaluated at post-change prices, required to compensate the consumer (i.e., to make the consumer as well off as in the initial situation). A scalar measure of this compensation is provided by the true cost-of-living index (Cornes). Using the consumer's budget constraint [as manifested in the expenditure function $e(\mathbf{p}, u)$], this index is defined as the uniform rate by which all prices facing the consumer in the final situation must be adjusted so that initial utility is preserved.

The TRI is based on a similar notion applied to a trading economy. Here, the analog of consumers' expenditure is the budget constraint of a trading economy which equates aggregate expenditure on *all* goods to total income (the latter being the sum of GNP and government revenue, generated by the various distortions in place, and redistributed to the aggregate consumer). Based on this budget constraint, the TRI is defined as a compensating variation measure of the trade distortions in place, relative to an initial welfare level. Specifically, for an initial period (0) and a final period (1), the TRI is defined as the uniform scaling factor by which all instruments of trade distortion (tariff rates, quota levels, etc.) in period 1 must be adjusted so that welfare level of period 0 is attained.

The budget constraint of a trading economy can be specified by subsuming the consumption and production sectors into a single function, called the *trade expenditure function*, which is defined as the difference between the aggregate expenditure function and the total revenue (or GNP) function (Neary and Schweinberger). As such, the trade expenditure function retains all the standard properties of expenditure functions. Given the importance of quantity restrictions in trade, the trade expenditure function also can be defined only for the price-constrained goods, *given* the existing quantity restrictions (e.g., quota levels). This gives rise to the *distorted trade expenditure function*, expressed in terms of prices, welfare, and quantity restrictions (Anderson and Neary 1992).

For a competitive trading economy imposing both price and quantity restrictions, its budget constraint also can be expressed by setting the sum of total expenditure and total income equal to zero, thus introducing a new function, denoted the *balance-of-trade function.* Formally, this function can be written as follows:[2]

$$(1) \qquad B(\mathbf{Q}, \pi, u; \gamma) = E^D(\mathbf{Q}, \pi, u) + \mathbf{p}'\mathbf{Q} - \tau'\mathbf{m}(\mathbf{Q}, \pi, u) - (1 - \omega)(\mathbf{p} - \mathbf{p}^*)'\mathbf{Q} = 0,$$

where $E^D(\cdot)$ denotes the distorted trade expenditure function, $\mathbf{Q}$ denotes quota levels, $\mathbf{p}$ is the price vector of quota-constrained goods, $\mathbf{m} = \mathbf{E}^D_\pi(\cdot)$ denotes import demand, π is the domestic price vector of tariff-ridden goods, τ is a vector of specific tariffs, γ denotes all parameters exogenous to the analysis, and $\mathbf{p}^*$ denotes exogenous world prices. Additionally, assuming incomplete retention of the quota rents at home, the scalar ω denotes the portion of quota rents accruing to the economy's foreign suppliers.[3]

Trade-related distortions often coexist with domestic distortions (e.g., policies regulating prices for the domestic producers, consumers, or both), distortions in nontraded goods, or distortions occurring in factor markets rather than final goods markets. Such distortions, however, can be incorporated into the present framework. Let vector $\mathbf{s}$ denote price distortions in nontraded goods, and $\mathbf{z}$ denote a vector of distortion parameters in factor markets. Through the respective expenditure and GNP functions, these variables become explicit arguments in the distorted balance-of-trade function, which is now written as $B(\pi, \mathbf{Q}, \mathbf{s}, \mathbf{z}, u) = 0$.

For any two periods 0 and 1, the TRI is now defined as the uniform proportional factor by which period-1 *policy variables of trade and domestic distortions on traded goods* must be adjusted so that the economy returns to period-0 welfare, u^0. Denoting the TRI by δ, its formal definition (Anderson and Neary 1994) is:

$$(2) \qquad \delta(\pi, \mathbf{Q}, u^0) \equiv \left[\delta \colon B\left(\pi^1\delta, \frac{\mathbf{Q}^1}{\delta}, \mathbf{s}, \mathbf{z}, u^0; \gamma\right) = 0\right].$$

[2] In principle, one may write $B(\cdot) = b$, with b denoting any net transfer from abroad including the balance-of-trade deficit (surplus). However, since b is largely determined outside the present framework of analysis (e.g., by central monetary authorities via exchange rate policies), it is assumed exogenous and may be set equal to zero without loss of generality.

[3] To simplify the analysis, ω is assumed invariant across commodities. To allow ω to vary across commodities, the last term on the right-hand side of (1) can be written as $(\mathbf{p} - \mathbf{p}^*)'(\mathbf{I} - \Omega)\mathbf{Q}$, where $\mathbf{I}$ is the identity matrix and Ω is a diagonal matrix with the different quota portions ω_i on the diagonal.

It may be noted that, as an index of trade restrictiveness, the TRI (δ) is *not* applied to distortion parameters referring to nontraded goods and factors markets: it is the uniform scaling factor applied to distortions on traded goods alone, however, which compensates the aggregate consumer for arbitrary changes in the markets of all (traded and nontraded) goods. If trade policies (π, $\mathbf{Q}$) do not change between periods 0 and 1, then $\delta = 1$. As the prices of tariff-ridden goods decline or quota levels increase, the rate of change ($d\delta/\delta$) of the TRI (and subsequently its magnitude) rises. Thus, an increase in the size of the TRI indicates the economy has liberalized its trade policy regime.

Implicitly assuming that δ equals one in the initial period, the rate of change ($d\delta/\delta$) may be obtained by totally differentiating (2):

(3)
$$\frac{d\delta}{\delta} \equiv \dot{\delta} = \frac{\sum_j (B_{Q_j} Q_j)\dot{Q}_j}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} + \frac{\sum_i (B_{\pi_i} \pi_i)\dot{\pi}_i}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} + \frac{1}{\delta}\left(\frac{\sum_k (B_{s_k} s_k)\dot{s}_k}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} + \frac{\sum_\ell (B_{z_\ell} z_\ell)\dot{z}_\ell}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} \right),$$

where a dot ($\cdot$) over a variable denotes a proportionate change (dQ_j/Q_j, $d\pi_i/\pi_i$, etc.). The derivatives $\mathbf{B}_\pi$ and $\mathbf{B}_Q$ are obtained by differentiating $B(\cdot)$ in (1) with respect to π and $\mathbf{Q}$, keeping in mind that by definition of the distorted trade expenditure function, its first derivatives are $\mathbf{E}_\pi^D(\cdot) = \mathbf{m}$, and $\mathbf{E}_Q^D(\cdot) = -\mathbf{p}$ (Anderson and Neary 1992). Thus,

(4)
$$\mathbf{B}_\pi' = -\tau'\mathbf{m}_\pi + \omega\mathbf{Q}'\mathbf{p}_\pi, \quad \text{and}$$

(5)
$$\mathbf{B}_Q' = -\tau'\mathbf{m}_Q + \omega\mathbf{Q}'\mathbf{p}_Q - (1-\omega)(\mathbf{p} - \mathbf{p}^*)'.$$

The derivatives of the import demand functions, $\mathbf{m}(\pi, \mathbf{Q}, u)$, and the inverse demand functions, $\mathbf{p}(\pi, \mathbf{Q}, u)$, can be expressed in terms of either the distorted $E^D(\cdot)$ or the standard trade expenditure function $E(\cdot)$ (Anderson and Neary 1992; Neary):

(6)
$$\mathbf{m}_Q = \mathbf{E}_{\pi Q}^D = \mathbf{E}_{\pi p}\mathbf{E}_{pp}^{-1}, \qquad \mathbf{m}_\pi = \mathbf{E}_{\pi\pi}^D = \mathbf{E}_{\pi\pi} - \mathbf{E}_{\pi p}\mathbf{E}_{pp}^{-1}\mathbf{E}_{p\pi};$$

(7)
$$\mathbf{p}_Q = -\mathbf{E}_{QQ}^D = \mathbf{E}_{pp}^{-1}, \qquad \mathbf{p}_\pi = -\mathbf{E}_{Q\pi}^D = -\mathbf{E}_{pp}^{-1}\mathbf{E}_{p\pi}.$$

It should be noted that the derivatives $-\mathbf{B}_\pi$ and $-\mathbf{B}_Q$ estimate the effect of changes in tariffs and quotas on the economy's welfare. Thus they can be interpreted as the marginal cost of tariffs and the shadow price of quotas, respectively. Accordingly, the term ($\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi$) equals the negative of the total cost of the initial trade structure (i.e., the welfare loss associated with the trade distortions), and it is denoted the "shadow value of distorted trade" (Anderson and Neary 1994).

As seen in (3), the TRI equals the weighted sum of: (*a*) the proportional changes in all trade and domestic distortions π and $\mathbf{Q}$ (with each component π_i and Q_j being weighted by its contribution to the total welfare loss of the initial trade regime), and (*b*) the proportional changes in nontraded goods prices $\mathbf{s}$, or factor market distortion parameters $\mathbf{z}$, each being weighted by the respective induced change in the balance-of-trade function and normalized by the total welfare loss.

An Empirical Application to Japanese Agricultural Products

Although Japan is one of the world's largest net importers of foodstuffs, its agricultural sector is characterized by a complex web of domestic support programs and trade intervention. In addition to conventional trade policies such as import tariffs and quotas, trade is also affected directly through state agencies or controlled indirectly via quasi-governmental agencies [e.g., the Livestock Industry Promotion Corporation (LIPC)].

This study focuses on Japanese agricultural programs[4] comprising an important set of trade and domestic restrictions (e.g., quotas on beef and citrus, and the ban on rice imports) that have been criticized throughout the 1980s by Japan's trading partners. Specifically, a TRI is estimated and used to assess the combined restrictiveness associated with domestic support and trade policies implemented on (*a*) beef, (*b*) pork, (*c*) poultry, (*d*) wheat, (*e*) rice, and (*f*) fresh oranges over the 1970–87 period.

Trade policies affecting these commodities (Australian Bureau of Agricultural and Resource Economics; Fitchett; Organization for Economic Cooperation and Development) are summarized below.

- *Beef.* Government intervention consisted of imposing annually a "price stabilization band" on beef prices and administering the beef sector via the state-controlled LIPC. The LIPC maintained domestic beef prices within this predetermined "band" by controlling both domestically produced and imported quantities released in the market. In practice, the LIPC manipulated the beef market by regulating the flow of imports via quotas, which were set semiannually. On top of the quota, beef imports were subject to a 25% ad valorem tariff.
- *Pork and Poultry.* Support programs consisted of "price stabilization bands" administered by the LIPC. Domestic pork prices were maintained within the respective "band" by means of a variable levy (instead of a quota). Pork imports were subject to the higher of either a 5% ad valorem tariff or a differential duty. The latter was applied whenever the import price was lower than the central price of the stabilization band, and was defined as the difference between the central price of the "band" and the import price. Domestic poultry prices were maintained by the LIPC at desired levels by imposing a 20% ad valorem tariff on all poultry imports.
- *Rice.* The rice industry was administered by Japan's governmental Food Agency, which annually determined producer and wholesale (user) prices. Throughout the 1970s and 1980s, rice imports were virtually banned (reflecting Japan's decision to maintain full self-sufficiency in rice); exports occurred only on an exceptional basis—as a means of disposing of rice surplus. High support prices, however, resulted in considerable domestic surpluses. Thus, during 1970–87, the Japanese administration introduced four land diversion programs to divert riceland toward priority crops (e.g., wheat). In all four programs, an acreage reduction target was set annually, and diversion payments were offered to participant farmers.

[4] In terms of import value, the commodities examined here represent 20–30% of the total value of Japanese imports in food and live animals during 1970–87. Insufficient information or lack of data did not allow consideration of a more comprehensive set of agricultural programs.

- *Wheat.* In contrast to rice, more than 80% of wheat in Japan was imported during the period of analysis. Nonetheless, the Food Agency set both producer and wholesale prices (as with rice), and directly administered all wheat imports. For domestically produced wheat, the differences between producer and wholesale prices were substantial, resulting in considerable government losses.
- *Fresh Oranges.* Imports of fresh oranges during 1970–87 were subject to quotas; additionally, a 20–40% tariff rate was imposed, depending on the time of importation (on-season, off-season imports).

The above trade policies include tariff-ridden goods (pork and poultry), quota-constrained goods (beef and fresh oranges), and state-controlled goods (rice and wheat), one of which (rice) is a nontraded good[5] in the Japanese market. The corresponding partial equilibrium budget constraint[6] requires that the value of aggregate consumer expenditure on these goods equal the sum of generated GNP plus government net revenues and transfers. These revenues and transfers include tariff revenues, quota rents,[7] net (producer/user) subsidies for the state-controlled goods, and riceland diversion payments. This equilibrium is summarized via the following distorted balance-of-trade function:[8]

$$\begin{aligned}(8)\qquad B(\mathbf{h}, \mathbf{s}, \rho, \mathbf{Q}, \mathbf{A}, u) \equiv\ & E^D(\mathbf{h}, \mathbf{s}, \rho, \mathbf{Q}, \mathbf{A}, u) \\ & + \mathbf{p}'\mathbf{Q} - (\mathbf{p} - \mathbf{p}^*)'\mathbf{Q} - \tau'\mathbf{m}(\mathbf{h}, \mathbf{s}, \rho, \mathbf{Q}, u) \\ & + (\rho - \sigma^*)'\mathbf{Y}(\rho) - (\mathbf{s} - \sigma^*)'\mathbf{X}(\mathbf{h}, \mathbf{s}, \mathbf{Q}, u) - cA = 0,\end{aligned}$$

where vector **h** denotes prices of the tariff-ridden goods, **Q** represents quota levels, ρ denotes producer prices for the state-controlled goods, **s** indicates wholesale (user) prices for the state-controlled goods, and σ and **p** denote the international prices of the state-controlled and the quota-constrained goods, respectively. $\mathbf{Y}(\cdot)$ and $\mathbf{X}(\cdot)$ denote the quantities supplied and demanded, respectively, of the state-controlled goods, A represents diverted acreage of riceland, and c is the per acre diversion payments made to rice growers.

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[5] Goods may not be traded for a number of reasons. Typically, nontraded goods include factors of production or final goods with high transportation costs or perishability. Although tradable in principle, rice in our study was steadily excluded from trade due to political considerations. As the TRI is defined only with respect to goods traded in finite, positive quantities and prices, the ban on rice imports (interpreted as a quota set steadily at zero) does not affect the rate of change of the index. Treating rice as a nontraded good in our analysis allows its domestic regulations to be taken implicitly into account in the computation of the TRI.

[6] Although the TRI is, in principle, a general equilibrium concept, its applications mostly have been in a partial equilibrium framework (Anderson and Neary 1994; Anderson, Bannister, and Neary). A major reason is that "in practice, its focus on trade policy instruments suggests choosing a highly disaggregated model to capture the fine detail of actual protective policies. This in turn suggests implementing the TRI in either a partial equilibrium model or a general equilibrium model with tightly specified structure" (Anderson and Neary 1994, p. 160). In the present study, the adopted partial equilibrium framework implies that any cross-effects from the examined protective policies on the rest of the economy (e.g., on factor markets, on nonagricultural production/consumption, etc.) are subsumed in the background.

[7] Full retention of quota rents is assumed for both beef and oranges, as imported beef reaches the domestic market via the quasi-governmental LIPC while the contribution of distortions of orange imports to the index is small.

[8] The distorted trade expenditure function $E^D(\cdot)$ is generally specified as $[e^D(\mathbf{h}, \mathbf{s}, \rho, \mathbf{Q}, u) - (g(\mathbf{h}, \mathbf{s}, \rho) + \mathbf{w}'\mathbf{V})]$, with functions $e^D(\cdot)$ and $g(\cdot)$ representing the aggregate *consumer* expenditure and profits on the tariff and state-controlled goods, and $\mathbf{w}'\mathbf{V}$ representing value of payments **w** to primary factors **V**, such as land, capital, etc.

Subsuming all domestic and trade-related distortions on prices into the same vector (π), the TRI associated with the set of the examined agricultural policies is defined as:

$$(9) \qquad \theta \equiv \left[\theta : B\left(\theta\pi^1, \frac{\mathbf{Q}^1}{\theta}, \rho_{rice}, s_{rice}, A, u^0 \right) = 0 \right],$$

and its proportionate change, $d\theta/\theta$, is given by total differentiation of the preceding expression:

$$(10) \qquad \frac{d\theta}{\theta} = \dot{\theta} = \frac{\sum_j (B_{Q_j} Q_j)\dot{Q}_j}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} + \frac{\sum_i (B_{\pi_i} \pi_i)\dot{\pi}_i}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} + \frac{1}{\theta}\left(\frac{B_{s_{rice}} s_{rice}}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} \dot{s}_{rice} + \frac{B_{\rho_{rice}} \rho_{rice}}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} \dot{\rho}_{rice} + \frac{B_A A}{\mathbf{B}_Q'\mathbf{Q} - \mathbf{B}_\pi'\pi} \dot{A} \right) = 0,$$

where the subscript i indexes pork, poultry, and wheat, and the subscript j indexes beef and fresh oranges.

Empirical Results and Analysis

Estimation of the index requires evaluation of the policy derivatives in (10) which involve price derivatives of demand and supply for the examined goods.[9] This study uses yearly estimates of own- and cross-price response of demand, obtained via the system-wide (or differential) approach (Theil 1967, 1980).[10] Due to lack of data, however, we rely on exogenous information about the price response of supply reported in the U.S. Department of Agriculture's Trade Liberalization Database (TLIB) (USDA 1989).

The empirical estimates for the TRI, as well as its component terms for the 1970–87 period, are presented in table 1. The rate of change ($d\theta/\theta$) of the TRI, which measures changes in the degree of trade liberalization in year t relative to the prior year, is shown in the last column as the sum of (weighted) proportional changes of its individual components. For each of the examined commodities, this component is the rate of change (with respect to the previous period, $t-1$) of the policy instrument applied on the commodity (be it domestic price, quota level, or diversion acreage) *times* a welfare loss-related weight as shown in (10).

Summing across the examined commodities, the rate of change of the TRI increases with lower prices (π) for tariff-ridden and state-traded goods, higher quotas (**Q**), and less land employed in rice production (which render the respective component terms positive). Hence, the rate of change of the index rises as the trade distortions (π, **Q**) and

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[9] The specification of the policy derivatives in (10) are available from the authors upon request.

[10] The Rotterdam model was used, and the examined goods were divided into two separable groups—the first including meat and grains (i.e., beef, pork, poultry, wheat, and rice), and the second including fresh oranges along with all citrus fruit (Pantzios). Oranges were separated because preliminary estimations including all six goods in a single group showed insignificant cross-price relations between oranges and the rest of the goods.

Table 1. Empirical Estimates and Component Terms for the TRI of Japanese Agricultural Imports, 1970–87

Year	Pork	Poultry	Wheat (demand)	Rice (demand)	Wheat (supply)	Rice (supply)	Beef	Oranges	Riceland Programs	TRI Weighted
1970										
1971	-0.02459	-0.03309	-3.3e-06	0.000114	-0.00113	-0.00243	0.152008	0.002241	0.862268	0.955389
1972	-0.01698	0.02461	0.000022	-0.00074	-0.00068	-0.004	0.119979	0.004022	0.101089	0.227323
1973	-0.01367	-0.0158	-0.00007	0.000029	-0.00117	-0.00598	0.367431	0.000886	-0.00698	0.324668
1974	-0.0369	-0.03618	-0.00021	-0.00284	-0.00325	-0.02111	-0.54561	0.002035	-0.70616	-1.35023
1975	-0.09505	-0.02049	-0.00002	-0.00294	-0.00142	-0.01334	-0.07086	0.000711	-0.0775	-0.2809
1976	-0.00117	-0.0052	-0.00014	-0.0013	-0.00087	-0.00501	0.318762	0.000586	-0.06777	0.237889
1977	0.006232	0.001564	-0.00003	-0.00112	-0.01491	-0.00305	-0.0596	-0.00038	0.017219	-0.05408
1978	0.025769	0.013365	0.000001	0	-0.00057	-0.00006	0.072784	0.005136	0.31105	0.427475
1979	0.037185	0.007626	3.11e-07	-0.00072	-0.00102	-0.00015	0.126254	0.000945	0.037107	0.207231
1980	-0.00702	-0.00944	-0.00006	-0.00063	-0.00408	-0.00225	-0.02736	0.004886	0.166777	0.120817
1981	-0.04444	-0.00927	-0.00002	-0.0005	-0.00143	-0.00035	-0.00084	0.001199	0.094097	0.038447
1982	0.013591	0.009637	-4.2e-06	-0.00104	0	-0.00137	-0.00378	0.00375	0.006114	0.026898
1983	-0.00216	0.004764	-0.00005	0	-0.00026	-0.00223	0.059956	0.002609	-0.04552	0.017113
1984	0.004486	0.002236	0.000001	-0.00105	0	-0.00284	0.029695	-0.00012	-0.01438	0.018021
1985	0.031799	0.010745	-4.3e-07	-0.00113	0.000712	0	0.021505	0.009789	-0.01489	0.058526
1986	0.006694	0.004628	-1.3e-06	-0.00035	0.002144	0	0.113283	0.001288	0.009488	0.137174
1987	0.012805	0.008617	0.000009	0	0.035188	0.004595	0.130345	0.001122	-0.00027	0.192411

the misallocation of resources (riceland) are reduced. Inspection of this rate of change in table 1 reveals that the value of the TRI is shaped primarily by changes in the riceland diversion program, the beef quota, and, to a lesser extent, pork and poultry prices. In contrast, the contributions of rice and wheat are minimal, reflecting the persistent policies of regulating the producer and consumer prices in both crops throughout the period examined.

As seen from table 1, the index exhibits considerable variation over the 1971–77 period, and a relatively smooth pattern over the 1978–87 period. In particular, during 1971–73, the index shows a positive but rapidly decreasing rate of change—thus implying that the trade restrictiveness of the examined policies is falling, albeit at a decreasing rate. This is the combined result of (*a*) an increase in the beef quota, orange quota, and riceland diversion (all of which raise liberalization) *at a diminishing rate*, and (*b*) a simultaneous rise in the domestic prices of pork and poultry (which contribute to more restrictiveness). In 1974, the rate of change of the TRI turns negative, implying a severe reduction in the magnitude of the TRI and therefore a dramatic increase in trade protection for that period. This severe drop of the index reflects the decision of the Japanese government to suspend the beef quota in late 1973, and to completely close the beef market to imports in 1974 until the second half of 1975 (Australian Bureau of Agricultural and Resource Economics). This was coupled with an increase of almost 12% in the wholesale pork price, a 13.5% increase in the wholesale price of poultry, and a 79.5% reduction in the amount of riceland diverted from rice production.

During the 1975–78 period, the index shows a slight increase as its rate of change becomes less negative in 1975 and turns positive in 1976, almost zero in 1977 (reflecting stable policies during 1976–77), and again positive in 1978 (reflecting higher beef imports, higher riceland diversion, and lower pork and poultry prices). Thereafter, the index shows less variation. Specifically, for the period 1978–84, the index exhibits a positive but decreasing rate of change as the beef quota was slightly reduced in 1980, 1981, and 1982, while pork and poultry prices rose and the diversion rate of riceland became smaller and even negative in 1983–84.

After 1984, the index's rate of change shows a steady increase, indicating a trade liberalization process at least for the period 1984–87. This is consistent with the so-called "1984 U.S.-Japan Beef and Citrus Understanding"—i.e., in August 1984, Japan agreed to expand its import quotas for fresh oranges and grain-fed beef mainly supplied by the U.S. (USDA 1984). This TRI steady increase also reflects decreasing domestic prices on pork and poultry, stable or even decreasing domestic prices in wheat and rice, and very small variation in the riceland diversion programs.

Table 2 presents the *level* of the TRI, computed as a simple difference equation (Anderson, Bannister, and Neary). In particular, the index is computed for each one of the periods 1971 through 1987 relative to the initial period 1970, which is normalized so that $\theta_{1970} = 1$. After dramatic increases and drops in the early and mid-1970s, respectively, the value of the index is consistently higher than one from the late 1970s and throughout the 1980s, indicating a slight liberalization trend. It is interesting to note that the value of the TRI in 1987 is 58% higher than in 1970. However, the value of the TRI in 1972 is twice as high as in the first period. Therefore, one must also note that the lower distortions in the end of the examined period are still more restrictive when compared to those in the beginning of the 1970s.

Table 2. The Level of the TRI of Japanese Agricultural Policies Relative to 1970, for the 1970–87 Period (1970 = 1)

Year	TRI Level	Year	TRI Level	Year	TRI Level
1970	1.00	1976	1.10	1982	1.67
1971	1.96	1977	0.99	1983	1.65
1972	2.08	1978	1.22	1984	1.49
1973	1.86	1979	1.38	1985	1.53
1974	0.93	1980	1.45	1986	1.64
1975	0.73	1981	1.34	1987	1.58

Anderson, Bannister, and Neary suggest decompositions of the TRI which allow some comparison with the more conventional measures of producer subsidy equivalents (PSEs) and consumer subsidy equivalents (CSEs). Along these lines, we have considered in our application two separate distortion indexes: a production-distortion index (δ^P) and a consumption-distortion index (δ^C). Both indexes are defined and computed analogously to the full TRI. However, δ^P considers only production-related distortions which are welfare-equivalent to policy changes from period 0 to period 1, and ignores policy variables related to consumption. Index δ^C is defined similarly for the consumption side.

Indexes δ^P and δ^C, computed for the period 1982–87, are compared with the aggregate PSE and CSE[11] of the examined goods in table 3. Starting with $\delta_{1982} = 1$, we compute the level of δ^P for each of the 1983–87 periods, relative to the 1982 base period. Findings show that the production-distortion index δ^P implies steadily diminishing production-related distortions during the 1982–87 period, as its value is higher than one throughout 1983–87. In contrast, the aggregate PSE in each of the 1983–87 periods implies higher production-related distortions when compared to the aggregate PSE of the 1982 period. Identical findings hold in comparing the consumption-distortion index δ^C with the aggregate CSE.

These contradictory conclusions are explained by the fundamentally different ways in which δ^P, δ^C, PSEs, and CSEs are constructed. The use of value shares as weights results in aggregate PSEs (CSEs) shaped primarily by goods with high production (consumption) value. Additionally, PSEs (CSEs) consider the variation in price in the cases of both tariff-ridden and quota-controlled goods; this conceals the fact that for quota-controlled goods, the distortion is founded in the available quantity, and therefore the variation in quantity is more relevant in evaluating distortions. The distortion indexes (δ^P and δ^C), on the other hand, consider explicitly either price or quantity variations of the examined goods, while their individual components are aggregated according to their contribution to the total welfare loss associated with the distortions in place. Methodologically, therefore, the explicit theoretical foundation of distortion indexes such as δ, δ^P, or δ^C makes the TRI approach more appealing in assessing trade liberalization over such ad hoc aggregate indicators as PSEs (CSEs).

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[11] The Japanese PSEs and CSEs for each of the examined goods during the period 1982–87 were obtained from the USDA (1988, 1990). Aggregates were obtained as weighted averages, using as weights the respective production (consumption) value shares.

Table 3. Comparison of the TRI with Producer and Consumer Subsidy Equivalents, 1982–87

Year	Aggregate PSE (yield/MT)	Level of Index (6^P for $6^P_{1982} = 1$)	Aggregate CSE (yield/MT)	Level of Index (6^C for $6^C_{1982} = 1$)
1982	310,951	1.00	-263,950	1.00
1983	342,365	1.02	-305,985	1.07
1984	336,236	1.06	-305,721	1.10
1985	328,767	1.13	-305,535	1.18
1986	391,267	1.26	-387,632	1.29
1987	396,640	1.41	-403,549	1.41

Conclusions

The TRI is an attractive measure for assessing the degree to which changes in policy regimes reflect, or fail to reflect, liberalized trade. Regarding the theoretical robustness of available protection indicators and their ability to cover diverse sets of distorting policies, the TRI has some potential advantages. These include a robust theoretical derivation, consistent and meaningful aggregation across commodities, and the explicit inclusion of nonprice distortions, thereby allowing modeling of a wide array of trade policies. Additionally, to the extent that interrelationships exist among the examined goods, cross-effects from changes in the examined policies are explicitly accounted for in computing the index's welfare weights [as may be seen in (4) and (5)].

However, since empirical implementation of the index can be difficult, the TRI lacks one of the most attractive characteristics of index numbers—ease of implementation. Its simplicity as a scalar measure of trade distortions also may be seen as a limitation. Subsuming complicated policy distortions in a simple index measure can create a "black box" problem; as these distortions are treated in a summary fashion, underlying specific policies and intermediate effects may be obscured.

The goals of this study were to evaluate the performance of an estimated TRI for a subset of Japanese agricultural products against known policy changes and other economic events over the 1970–87 period, and to compare the inferences obtained from the TRI with a competing measure, the PSE/CSE. The estimated TRI suggested that the degree of liberalization (or protectionism) implied by Japanese trade policies was determined primarily by changes in the riceland diversion program and in the quota on beef. Policies affecting pork and poultry prices were also significant. The behavior of the index over the 1970–87 period provides some interesting insight into the degree of liberalization implied by policies affecting the subsector analyzed. Using 1970 as the base period, the TRI suggests that, in 1987, policy changes over the period have resulted in moderately liberalized trade. Additionally, the policy changes consistently represented liberalized trade since 1977. The index also suggests that the observed changes in the beef and citrus quotas in the early 1970s resulted in significant trade liberalization.

A comparison of the TRI approach with an aggregated PSE/CSE calculated over the 1983–87 period provided substantially different inferences about the effects of changes in trade policies affecting the subsector analyzed. Admittedly, the two measures may not be directly comparable; they differ in their definitions, and the policies they cover may not be precisely the same. However, these differences may well be related to the choice of weights in estimating the two measures. Regardless of where the differences lay, the present analysis suggests that the measure used to assess the degree of trade liberalization (or protectionism) can substantially impact the inferences obtained.

It is always a bit risky to use economic intuition as a measuring stick. However, based on the performance of the TRI over the period of analysis, it appears that the estimated TRI provides measures in general accordance with what would be expected given observed policy changes and economic events over the 1970–87 period. Additionally, based on the comparison between the TRI and PSE/CSE, it appears that the choice of index used to assess the degree of trade liberalization can, in fact, matter—and matter a lot. While these findings must be considered in the context of the modest analysis attempted here, it is hoped that the implications of this study will spur additional research on the performance of the TRI in order to provide more generalizable conclusions.

[*Received August 1997; final revision received April 1998.*]

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