Bilateral Trading Relationships:

A Trade Flow Model of Australia-Japan and U.S.A.-Japan Trade in Three Primary Commodities - Coal, Beef and Wheat

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Introduction

The purpose of this study is to consider the nature of the Australia-Japan trading relationship for a limited number of commodities and how it has changed in recent years. Emphasis is placed on trading preferences, how these preferences can be expressed in quantitative terms and how stable they are over time and across commodity types.

The importance of the Japan-Australia trading relationship to the Australian economy is well documented and widely recognized. Growing from one of comparative insignificance in the early 1950s when exports to Japan comprised 6 per cent of Australia's total exports and imports just 2 per cent of Australia's import bill, the Japaneses market by the early 1980s absorbed around 27 per cent of all Australian exports and was the source of about 21 per cent of Australian imports.

One of the most durable elements of this expanding and diversifying trading relationship has been the trade in agricultural commodities. While minerals and energy products became the leaders in export share during the 1970s and early 1980s, agricultural commodities have maintained a significant 25-30 per cent of the value of Australia's total exports to Japan in recent years. Among suppliers of foodstuffs to the Japanese market, Australia currently ranks second to the United States.

The three commodities under study here coal, beef and wheat, are representative of the type of goods exported by Australia to Japan i.e. predominately unprocessed or partially processed mineral and agricultural products. Emphasis in the study is placed on Australian supplies of these commodities in the context of other major suppliers to the Japanese market. In the case of beef the other significant supplier is the United States, while for wheat and coal the U.S. and Canada together with Australia meet most of Japan's import demands.

Despite the strength and prosperity of the Australia-Japan agricultural trading relationship it has been the centre of some of the most controversial disputes between the two countries over the past 10 to 15 years. The most contentious issue over this period has been the existence and extent of import quotas, tariffs and non-tariff barriers which form the basis of the Japanese Government's agricultural price support arrangements (George 1983, Longworth 1983, BAE 1987). Japan has been consistently pressed by both Australia and the United States to open up its markets by reducing its restrictive import controls and allowing greater access for farm products.

A widely held fear in Australia and many other third country suppliers is that Japan will respond to U.S. trade pressures on a special bilateral basis.

> "In the course of U.S. negotiations with Japan on levels of Japanese agricultural protectionism, the question of market liberalisation has become inextricably linked with the highly visible issue of Japan's massive bilateral trade surplus with the U.S. Increased sales of American farm products to Japan are seen as one means of redressing the U.S.-Japan trade imbalance" (George 1983, p. 2).

Recent trends in Australia-Japan agricultural trade, discussed in detail by George (1983), show that while there has been a relative decline in market share for Australian agricultural products in the Japanese market there has been a corresponding increase in imports from the United States (see Table 1). It is suggested by George that "Australia's agricultural exports to Japan might be significantly affected by a wider Japanese policy of preferences for American farm products over Australian supplies" (George 1983, p. 3).

While George offered detailed explanations of the changes in the pattern of Japan's agricultural import trade, no attempt was made to gauge the existence and statistical significance of apparent relationships. In this paper the traditional gravity type trade flow model is considered and developed in a way suitable for the analysis of the changing preferences of trading nations. An attempt is made in this study to (i) quantitatively consider the effect of economic community or bilateral trade agreements on third (non-member) countries; (ii) incorporate the Savage-Deutsch probability approach into a gravity trade flow model and cast this model in a time-series framework; and (iii) explicitly specify and estimate resistance variables, usually proxied by a single distance variable in the normal cross-sectional analysis.

TABLE 1 SOURCE OF JAPAN'S COAL, BEEF AND WHEAT IMPORTS: 1975 &1983

Commodity / Country, Year	United States 1975	United States 1983	Australia 1975	Australia 1983	Canada 1975	Canada 1983
Coal:						
'000mt	22,418	15,647	23,000	36,010	10,767	10,816
%(of total Ms)	(36.1)	(21.0)	(37.0)	(62.7)	(17.3)	(14.5)
Beef:						
mt	3,545	37,712	37,109	90,952		
%(of total Ms)	(7.9)	(27.4)	(82.6)	(66.2)		
Wheat:						
'000mt	3,004	3,348	1,174	983	1,476	1,415
%(of total Ms)	(53.1)	(58.3)	(20.8)	(17.1)	(26.1)	(24.6)

The Model

The standard trade flow gravity model is normally specified as:

$$M_{ij} = h(Y_i, Y_j, N_i, N_j, R_{ij}) \qquad (1)$$

or in functional form as:

$$M_{ijk} = \alpha_k Y_i^{\beta 1k} Y_j^{\beta 2k} N_i^{\beta 3k} N_j^{\beta 4k} d_{ij}^{\beta 5k} U_{ijk} \qquad (2)$$

where M_{ijk} is the dollar flow of good or factor k from country i to country j, Y_i and Y_j are national income levels in i and j, N_i and N_j are population levels in i and j, and d_{ij} is the distance between countries i and j. U_{ijk} is a lognormally distributed error term with $E(\ln U_{ijk}) = 0$ (Anderson 1979). Often the flows are aggregated across goods and usually the equation is estimated using cross-sectional data.

Although not stated explicitly, the income and employment variables in the usual gravity model are in effect used to estimate the total value (or quantity) of exports and imports of the trading countries, while the resistance variable is used to determine the direction and relative size of flows between countries. Consider the nxn trade flow matrix below in Figure 1.

$$\begin{array}{|cccccc|c}
\hline
0 & M_{12} & \cdot\ \cdot & M_{1j} & \cdot\ \cdot & M_{1n} & V_1^x \\
M_{21} & 0 & & & & M_{2n} & V_2^x \\
\cdot & \cdot & \cdot\ \cdot & \cdot & \cdot\ \cdot & \cdot & \cdot \\
M_{i1} & M_{i2} & \cdot\ \cdot & \cdot & \cdot\ \cdot & M_{in} & V_i^x \\
\cdot & \cdot & \cdot\ \cdot & \cdot & \cdot\ \cdot & \cdot & \cdot \\
M_{n1} & M_{n2} & \cdot\ \cdot & M_{nj} & \cdot\ \cdot & 0 & V_n^x \\
\hline
V_1^m & V_2^m & \cdot\ \cdot & V_j^m & \cdot\ \cdot & V_n^m &
\end{array}$$

Figure 1: Trade Flow Matrix

The row and column totals (V_i^x and V_j^m) indicate the total exports and imports of the particular countries and can be thought of as the quantities estimated by income and employment in the traditional model.

In estimating the trade flows (M_{ij}), one of two approaches can be taken. The traditional gravity model can be adopted where the national income and population variables are employed (with some resistance variable) to estimate total imports and exports plus the size and direction of the trade flow. Alternatively, the V_i^x and V_j^m values can be assumed to be known and they can be used as explanatory variables in estimating the trade flow values (M_{ij}) (Leamer and Stern 1970).

While the former approach is that most often adopted in the literature it is argued that the latter is more appropriate in the present study. An important objective of this paper is to consider the direction of trade flows between countries and how they change over time. Consequently, emphasis is placed on the resistance variables and their temporal variations rather than on factors determining the absolute size of trade. Further, export quantities of the commodities examined here (wheat, beef and coal) are, as suggested above, not particularly suitable for estimation using national income and employment variables. Also, any such relationship that may exist for the exporting countries, certainly does not hold in Japan, as total imports for all three commodities are fixed by quota.

Accordingly, equation (1) can be written as

$$M_{ij} = h(V_i^x, V_j^m, R_{ij}) \qquad (3)$$

where V_i^x and V_j^m are the total exports and imports of the particular commodity of countries i and j respectively. (Commodity subscripts have been discarded for clarity.)

While V_i^x and V_j^m could be left in the model as separate independent variables, a conceptually neater specification, with just a single variable representing "expected" trade flow was preferred. Also the number of observations (14 years) in the empirical analysis meant there was a shortage of degrees of freedom, made all the more acute by a desire to include a number of independent variables explaining different aspects of the resistance factor.

Following Savage and Deutsch (1960), assume that total world trade in a particular year consists of a large number of transactions (N) with an average size (B). Let V_i^x/T_k be the probability that an individual consignment originates from exporting country i (T_k is total world trade) and V_j^m/T_k be the probability that an individual consignment terminates in importing country j. Logically, the probability that a particular consignment is shipped from country i to country j is the product of the two i.e.

$$P(M_{ij}) = V_i^x . V_j^m / T_k \tag{4}$$

A weakness of this probability specification is that it makes no allowance for the fact that when (i = j), $P(M_{ij}) = 0$. This can be overcome by either generalising the model to include internal flows or amending it to restrict $P(M_{ij})$ to zero. Again following Savage and Deutsch, the latter approach is taken, excluding the possibility of a country receiving its own exports.

$$P(M_{ij}) = \begin{cases} SP_iQ_j & \text{for } i=j \\ 0 & \text{for } i=j \end{cases} \tag{5}$$

where
$$S = (1 - \Sigma_{i=1}^{k} P_iQ_j)^{-1} \tag{6}$$

P_i is a hypothetical "probability" associated with the tendency of i to export, Q_j is a hypothetical "probability" associated with the tendency of j to import i.e. accept imports, k is the number of countries involved including the "rest of the world", and S is a correction factor for excluding exports from any country to itself. S then is a constant expressing the increase in the probability of each trade flow caused by the exclusion of the possibility of any exports re-entering their country of origin.[1]

If N is the number of consignments then the value or quantity of trade between countries i and j can be expressed as:

$$M_{ij} = \Sigma_{m=i}^{N} B_m x_{ijm} \tag{7}$$

where B_m is the value or size of the m^{th} consignment and x_{ijm} is a random variable equal to one if the m^{th} consignment originates in country i and terminates in country j, and zero otherwise.

If we think of the consignments $B_1, \ldots B_N$ as a random sample from the population of possible consignments, which are statistically independent with a mean B, then

$$E(M_{ij}) = E_{ij} = BNSP_iQ_j \tag{8}$$

where BN is equivalent to T, the total value (or quantity) of trade. Accordingly equation (3) can be respecified, substituting E_{ij} for V_i^x and V_j^m. As emphasized above, this study is concerned with the identification of resistance factors and their variation over time. To this end it is obviously more appropriate to consider the model in a time-series framework than in the traditional cross-sectional specification. Thus, equation (3) now becomes:

$$M_{ijt} = h(E_{ijt}, R_{ijt}) \tag{9}$$

where t denotes time period t.

A variety of influences are subsumed in the resistance factor R_{ij}, which would seem to fall into two general categories, viz. natural trade obstacles and artificial trade impediments. The variables most commonly cited as contributing to "natural" resistance include transportation costs (in cross-sectional studies usually proxied by some distance variable), relative prices among competing nations[2] and factors relating to the "economic horizon" and "psychic distance" of a country.

The second category of trade impediments, the artificial obstacles to international trade, is comprised of a wide variety of complex and diversified factors. These trade impediments arise when goods are not allowed freely to pass a country's national borders. They are created, maintained, or removed by government action only and usually take the form of quantitative restrictions, tariffs, exchange controls, or a combination of these. Despite the fact that such artificial trade obstacles are simply data published for each country in a number of official documents they are not at all easy to incorporate as explanatory variables in a trade flow model. In the context of the present analysis, tariffs levels and quotas are not discriminatory between countries and, although they may change over time, they do change uniformly. A more effective approach is to include an "institutional" variable indicating the existence or otherwise of some special bilateral (or community) trade agreement. These types of agreements may not always be officially formalized but can nevertheless be just as effective in "freeing" trade for the parties involved and creating obstacles for third countries.

Consequently, the general resistance variables R_{ij} can be replaced by a set of more precise explanators. Equation (9) becomes:

$$M_{ijt} = h(E_{ijt}, \frac{P_{it}}{P_{gt}}, \frac{C_{it}}{C_{gt}}, I_t, L_t, M_{ijt-1}) \qquad (10)$$

where P_{it}/P_{gt} is the price of the commodity from exporting country i relative to that in exporting country g (Note, if more than one country is competing with country i in j's market then Pg will become the (weighted) average price of those competing countries.);

C_{it}/C_{gt} is the per unit transportation cost from exporting country i to importing country j relative to that from country g to j;

I_t is an institutional preference variable, a dummy variable indicating the existence or otherwise of some bilateral or trading group agreement;

L_t is another dummy variable indicating similarity or otherwise in the language and customs of the two trading countries. Important in cross-sectional studies but will remain relatively constant over time and could probably be left out of a time-series study;

M_{ijt-1} is the lagged dependent variable, providing a useful indicator or business co-operation and interaction. As misunderstandings of different customs and business practices are overcome then trade would be, ceteris paribus, expected to increase. If the variable L_t is excluded then M_{ijt-1} may pick up some of the effects if familiarity of customs and language between two countries does exhibit some change over time.

From equation (10) and following the general form of (2) the estimated form of the equation is obtained:

$$M_{ijt} = \alpha E_{ijt}^{\beta 1}\left(\frac{P_{it}}{P_{gt}}\right)^{\beta 2}\left(\frac{P_{it}}{C_{gt}}\right)^{\beta 3} I_t^{\beta 4} M_{ijt-1} U_{ijt} \qquad (11)$$

where U_{ijt} is a lognormally distributed error term with $E(\ln U_{ijt}) = 0$.

The expected values of the parameters to be estimated are fairly straigthforward. β_1 should be positive as an increase in the expected value of the dependent variable should be strongly correlated to an actual increase in bilateral trade. The coefficients of the relative price variables (β_2 and β_3) both, of course, are expected to be negative. β_4 may be positive or negative, depending on the nature of the trade agreement. If it is an agreement that includes both country i and j then it would have an expected positive value. If only one country is included then the expected sign would be negative.[3] The sign of the lagged dependent variable is also ambiguous. It would normally be expected to have a positive coefficient, indicating some improvement in business ties and cultural understanding over time, but may be negative in the case where such understanding is regressive, at least in relative terms (i.e. relative to other countries exporting to importing country j).

Data

The study covers the 14 years from 1970 to 1983 and was carried out for three commodity groups - beef, wheat and coal. These three goods are imports that Japan sources primarily in just two countries (the U.S. and Australia) in the case of beef and three countries (the U.S., Australia and Canada) for wheat and coal. Thus, the effect of some change in bilateral trading agreements on third countries should be relatively easily detected. Further, the results for the two agricultural commodities (beef and wheat) should provide some interesting contrasts as non 'rest of world' countries constitute by far the major market for the beef exporting countries but take only around 10 per cent of total exports from each of the wheat exporting countries.

Added to this, it has been fairly clear that Japanese Government policy has favoured U.S. exports of agricultural goods since the late 1970s, while Australia seems to have been the beneficiary of some preferential treatment in the sourcing of Japan's imports of energy resources. This difference should provide a useful test of the model's sensitivity to different types of changes in trading relationships.

A detailed country by country consideration of each commodity, would require details of every nations exports by country of destination. Not only are these not always available but interest lay mainly in the changing trading patterns between Australia and Japan and the United States of Japan. Consequently collection of data was confined to those countries supplying the majority of Japan's import requirements.

The 1970 to 1980 section of the series was available in World Trade Annual published by the United Nations. The final three years of the series (1981-83) were drawn from the annual editions of export and import statistics issued by the governments of each of the respective countries involved.[4] When discrepancies appeared between exports of one country and the corresponding imports of another, the import value was preferred and the total exports of the exporting country adjusted accordingly.

Obtaining a complete time series for commodity prices and transportation costs is at best extremely time consuming and often impossible. The approach adopted was to estimate a composite price variable incorporating both the f.o.b. valuation of the commodity and all the transportation related costs. The value of imports on a commodity by country basis given in Japan Exports and Imports (Nihon Boeki Geppyo) provides a consistent series over the fourteen years of the study.

The difficulty of identifying some significant change in government policy (and thus trading preferences) varied according to the type of commodity. In the case of beef, 1978 was the year in which intense pressure for liberalisation of the market was exerted on Japan by the U.S., particularly at the time of the visit of Special Trade Representative, Strauss, to Japan and the subsequent negotiations at the Tokyo Round of the MTN (Houck 1982). A specific demand of the United States at the MTN talks was that Japan should expand American beef imports to a quarter of its total beef imports (Sato and Curran 1980). Under such pressure Japan agreed in a bilateral settlement with the U.S. to increase imports of high quality grainfed beef.

> "Although the Japanese beef quotas remained global, a separate identifiable product (high quality, grainfed beef) was created, most of which the U.S. could confidently expect to supply because of the specifications for the meat in the beef tenders set down principally by the Livestock Industry Promotion Corporation ... Both the purpose and effect of the Japanese agreeing to the U.S. request to increase imports of high quality grainfed beef has been to earmark this section of the trade for American exporters" (George 1983, pp. 31-32).

Turning to wheat, the general decline in purchases of feed wheat from Australia since 1979 and a corresponding increase in imports from the U.S. suggests some change in government policy.[5] At that time "... Japan was reacting to U.S. pressure not only to buy more American farm goods in general, but also to take a greater quantity of U.S. soft wheat exports" (George 1983, p. 37). General trends of this nature appeared to reflect a conscious policy on the part of the Japanese to boost purchases of American farm commodities in an effort to reduce its surplus with the U.S.

> "Japanese Food Agency officials have themselves admitted to the need to purchase great quantities of agricultural goods from the U.S. in order to offset the Japanese trade surplus. This attitude is also evident in the sourcing of Japan's food aid, particularly of the non-rice food grains, where a clear preference has been shown for American grains over supplies from other major grain exporters" (George 1983, pp. 22-23).

With regard to Japanese coal imports, evidence of policy change on a bilateral basis is not as obvious. In the late 1970s, however, there appeared to be a general change in mood which, in contrast to policy regarding agricultural commodities, allowed some preference for Australian coal over other supplier countries. Okita (1982) notes that from the late 1970s through to the early 1980s imports of many types of raw materials for heavy industry was expected and did decline. In the case of coal, however, imports increased almost all of which came from Australia. Related to this Kojima (1982) points out that while in 1979 Australian still maintained an import surplus ratio of 2 to 1, pressure from within Japan to correct this imbalance was modified as it was recognized that a trade deficit is inevitable. Efforts were directed more toward maintaining the benefits of being able to procure natural resource based goods from Australia on a stable basis. These efforts have in part been the direct result of the Basic Treaty of Friendship and Co-operation between Australia and Japan[6] which states explicitly in Article IV:

> 'The contracting parties, recognising the importance to them of mineral resources, including energy resources, shall co-operate in the trade and development of those resources.'

Results

Using the least squares regression method, the following variant of the model presented in equation (11) was estimated for the period 1970 to 1983.

$$\log M_{ijt} = \log\alpha + \beta_1 \log E_{ijt} + \beta_2 \log P_{ijt-1} + \beta_3 \log I_t + \beta_4 \log M_{ijt-1} + \log U_{ijt} \qquad (12)$$

where P_{ijt-1} is a composite price variable (as described above) lagged one period.

Table 2 contains the estimated parameter values for the trade flow equations for the three commodities beef, wheat and coal for Australia-Japan trade. Estimated values for U.S.-Japan trade are shown in Table 3. In general the estimated coefficients come close to fitting the expected theoretical pattern.

First consider the results for Australia-Japan trade (Table 2). For each equation the expected flow (E_{ijt}) coefficient is positive and highly significant. E_{ijt} clearly contributes strongly to the explanatory power of each equation. The coefficients for the lagged price variables all have the expected negative sign although, in the case of wheat, it is not significantly different from zero. This indicates that wheat may not be particularly price responsive on world markets. According to the elasticity of substitution model "importers should tend to transfer imports from those exporters whose prices have risen to those whose prices have fallen. Empirically, however, the situation with respect to wheat is different, for export prices from various sources tend to move together in such a way that relative prices are much the same" (Konandreas and Hurtado 1978, p. 11).

TABLE 2 REGRESSION EQUATIONS FOR COMMODITY TRADE FLOWS: AUSTRALIA-JAPAN

(GRAVITY TYPE MODEL)

Commodity	Constant	Coefficients of Independent Variables[a]				R^2	D.W.
		E_{ijt}	P_{ijt-1}	I_t	M_{ijt-1}		
Coal	0.578	0.616 (4.223)	-0.140 (-2.635)	0.263 (4.431)	0.205 (1.241)	.95	1.84
Beef	0.040	1.046 (16.046)	-0.184 (-2.059)	-0.130 (-1.262)	-0.018 (-1.637)	.99	0.76
Wheat[b]	0.876	0.917 (7.408)	-0.381 (-0.515)	-0.223 (-1.169)	-1.844 (-0.296)	.88	2.45

a. M_{ijt} is the dependent variable; all variables are expressed in logs; t-values are shown in brackets, where 1.108, 1.397 and 1.860 are significant at the 0.85, 0.90 and 0.95 levels respectively.

b. The crictical values are slightly higher for the wheat equation (since the number of observations was reduced by two) but not enough to change the corresponding levels of significance indicated by the critical values given in footnote a.

TABLE 3 REGRESSION EQUATIONS FOR COMMODITY TRADE FLOWS: U.S.A.-JAPAN

(GRAVITY TYPE MODEL)

Commodity	Constant	Coefficients of Independent Variables[a]				R^2	D.W.
		E_{ijt}	P_{ijt-1}	I_t	M_{ijt-1}		
Coal	-1.030	1.265 (10.753)	-0.118 (-1.701)	-0.304 (-4.117)	-0.041 (-0.483)	.93	2.13
Beef	4.654	0.391 (1.665)	-0.166 (-1.601)	0.908 (1.164)	0.185 (0.751)	.76	1.81
Wheat[b]	3.535	0.482 (3.282)	-0.097 (-0.242)	0.028 (1.362)	0.078 (0.347)	.54	2.38

a,b See footnotes Table 5.

The most interesting results were those for the "institutional" or preference variable (I_t). As expected the coefficient was negative for the beef and wheat equations (although only significantly different from zero at the 0.85 level) and positive for the coal equation. The results for the agricultural commodities lend empirical support to the arguments put forward by George (1983) suggesting political decisions vis-a-vis U.S.-Japan trade have had an adverse effect on Australia-Japan agricultural trade.

It should be noted that the institutional variable in the coal equation denotes the existence or otherwise of some preferential trading relationship between Australia and Japan. In the beef and wheat equations it indicates the existence or otherwise of a similar relationship, but between the U.S. and Japan rather than Australia and Japan.

The estimated coefficients for the lagged dependent variable also varied according to the commodity group. If this variable reflects in some way the knowledge and awareness of the trading partner's business practices, customs, etc. then the gap between Australia's beef and wheat traders and negotiators and their Japanese counterparts would seem to be widening, relative to that between other exporting countries and Japan.[7] The results for the coal equation indicates improving business relationships. Since the signs are the same as on the coefficient of the dummy variable in each of the three equations it is possible that the two variables are picking up similar effects. Reestimating the equations without the lagged dependent variable had little effect on the R^2 value and resulted in slightly lower standard errors for the remaining independent variables.

Turning to the U.S.-Japan results (Table 3), some similarities and interesting differences can be found with the Australia-Japan results (Table 2). As suggested above, the price of wheat is not a significant determinant of international trade flows and the estimated coefficient is again not significantly different from zero (although it does have the expected negative sign).

The results for the preference variable (I_t) are once again most interesting. The estimated parameters in the beef and wheat equations have the expected positive signs although, again, only significant at the

85 per cent level. The results suggest that political and administrative processes have had a positive effect on U.S.-Japan trade in wheat and beef. While the results in Table 2 showed the benefits of 'institutional interference' for Australia-Japan trade in coal, the adverse effect on U.S.-Japan trade is clearly illustrated in the coal equation in Table 3.

Summary and Conclusions

A trade flow model was developed using the traditional gravity model as a starting point. The "gravity" variables were replaced by a single expected trade variable, derived from a previously developed probabilistic model. The trade flow model was set in a time-series framework and efforts were concentrated on specifying the factors contributing to resistance to bilateral trade over time.

The empirical findings of the study were found to be generally consistent with the expectations of the theoretical model. The results showed, in the case of Australia-Japan trade, that a significant expansion in coal trade has occurred as a result of bilateral trading agreements. Similar increases in U.S.-Japan trade in beef and wheat have occurred in response to positive administrative measures. These unsurprising results are similar to those found in several other studies concerned with multi-member economic trading communities (such as Aitken 1973, Brada and Mendez 1983). More importantly, the model was successfully able to pick up the effect that bilateral trading agreements can have on third countries. For example, Japanese preference for American agricultural commodities (wheat and beef) was shown to have a negative and significant impact on Japanese preferences for Australian exports, while preference for Australian coal has had an adverse effect on U.S.-Japan coal trade.

An implicit assumption of the model is that commodities are homogeneous across countries and over time. Due to aggregation and the very nature of agriculture commodities this is not always a realistic assumption. In the case of wheat, quality may change from year to year, depending on seasonal conditions which substantially affect the possible end uses of the grain. Quality changes will naturally affect importing preferences. Changes in technology can change industrial input requirements and cause substitution within broad commodity groups. At the level of aggregation adopted here coal includes both coking and steaming coal. The oil crises during the 1970s created a surge in demand for steaming coal while technological advances reduced the demand for coking coal. These types of changes may cause significant variation in the level of trade that will not be captured by the model. Clearly, further disaggregation is desirable to overcome problems of quality differences (in, say, the case of wheat) and changes in taste or industrial requirements (in the case of coal).

The model may also benefit if beef was disaggregated into, say, fed and non-fed beef. Such disaggregation is difficult although some recent attempts (e.g. Martin 1983) have provided promising results. Nevertheless, it is not possible to obta[illegible] [illegible]urate data on the levels and prices of low and high quality be[illegible] duced in most countries, apart perhaps from the North American market. Even if the figures were available the quality criteria would be very different in various countries (Goddard 1984, pp. 53-54).

Tests on a broader range of commodities would also be useful. The results were, from the point of view of statistical significance, least successful for the wheat equation which could be distinguished from the other two commodities by the fact that the exports to Japan constituted only a small percentage of the total exports for each of the exporting countries. This suggests the model may not be as powerful when the trade flows considered are not highly significant for each of the countries involved. This also requires further investigation.

As always, more complete data series may improve the estimates, as may finer disaggregation of the commodity groupings (particularly for estimation of the price coefficients). Finally, some further consideration should be given to more efficient means of specifying the preference variable (I_t), here proxied by a dummy variable.

Footnotes

1. Savage and Deutsch (1960, pp. 556-57) prove furthermore that

$$V_i^x/T \quad SP_i(1-Q_i) \qquad (i=1, \ldots, k) \qquad (i)$$

and $$V_j^m/T \quad SQ_j(1-P_j) \qquad (j=1, \ldots, k) \qquad (ii)$$

With the constraints

$$P_i \geq 0 ; \quad Q_j \geq 0 ;$$

$$\Sigma_{i=1}^{k} P_i = 1.0 ; \Sigma_{j-1}^{k} Q_j = 1.0 \qquad (iii)$$

the set of 2K equations ((i) and (ii)) can be solved to find values for P_i and Q_j. An iterative procedure, proposed by Goodman (1963, pp. 200-201), was used to obtain the solutions.

2. Although the long run equality of supply and demand on the world market implies that no country can have, in the long run, "too low" a price level or "too high" a price level, short-term price differences will affect a country's competitiveness vis-a-vis other exporting countries.

3. The general specification I_t could be replaced by separate independent variables to allow for each possibility, overcoming the ambiguity (e.g. I_{ijt}, I_{igt} and I_{gjt} where g is a third country or trading group).

4. Because of gaps in the data, the series for wheat only covered the years 1970 to 1981.

5. Although the Japanese Food Agency purchases wheat through 28 designated private trading houses which act as importing agencies, it is the Food Agency itself which determines the specifications relating to type and grades of wheat to be imported. Because wheat types and grades vary according to supply source the decision regarding quantities rests with the Food Agency. In this manner the Japanese Government can allocate the trade amongst its various trading partners (George 1983, p. 36).

6. Reprinted as an appendix in Walker and Jacobs (pp. 37-39). The treaty was ratified by both parties on 21 July 1977 and entered into force on 21 August 1977. While trade in energy resources (such as coal) was specifically mentioned for special treatment in the Treaty no such mention was made of agricultural commodities.

7. Note that the coefficient in the wheat equation, although negative, is not significantly different from zero.

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