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STRATEGIC MODELS, MARKET STRUCTURE, AND STATE TRADING: AN APPLICATION TO AGRICULTURE

by

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The purpose of this paper is to examine the strategic use of trade policy when homogeneous products are competitively produced, but their marketing is imperfectly competitive. This type of imperfect competition occurs in agricultural markets when state trading agencies or marketing boards are the sole marketing agents for products. It has also been hypothesized to occur in private trade of some agricultural products, but the extent of the market power of private traders is a highly controversial issue. Since the large U.S.S.R. purchases of grain in the mid-1970's, the competitiveness of the U.S. grain exporting industry has been highly disputed. Some have argued that high concentration ratios for the largest exporting firms indicate market power (Gilmore (1982)), while others argue that arbitrage opportunities and frequent entry and exit of firms indicate a relatively competitive market (Caves (1978), Caves and Pugel (1982), Thompson and Dahl (1979)).

The paper focuses on how the presence of state trading and the competitiveness of private trade affect optimal government policy. By examining a model in which a marketing board and private exporters are Cournot rivals in the world market for a competitively produced good, we show that optimal policy is sensitive both to the manner in which marketing boards operate and to the degree of competition in private export trade. The empirical analysis focuses on the importance of state trading in the world wheat market. Since the United States is the major private trader of wheat, we examine the competitiveness of the U. S. grain export sector.

There is a wealth of literature examining the implications of imperfect competition in agricultural markets, but most of it focuses on countries as units with market power and abstracts from issues relating to whether marketing is done by state agencies or trading companies.[1] The only study to examine the impact of marketing institutions on optimal government policy is by Just, Schmitz, and Zilberman (1979). They analyze a model in which a single marketing agent price discriminates between domestic and foreign markets and the government determines policy to maximize the sum of domestic consumer and producer surplus. They show that as long as the government does not regulate the domestic pricing of the agent and can subsidize domestic consumption and production, free trade is the optimal trade policy. This result is the same whether the marketing agent is a board which maximizes producer surplus or a monopoly-monopsonist which maximizes profits. If, however, the government forces a competitive price in the domestic market, it should tax exports of a marketing board and subsidize exports if the agent is a monopoly-monopsonist. The major shortcoming of the analysis is that it ignores the strategic interaction of firms and governments when more than one country exports a product.

The "new" literature on the strategic use of trade policy under imperfect competition has, however, largely ignored the types of imperfect competition that can occur in agricultural markets. Dixit (1984) and Eaton and Grossman (1986) note imperfect competition in distribution as a reason for imperfectly competitive trade, but recent models examining government policy have focused on markets with oligopolistic producers. This is not surprising since the insights of these models have concerned the potential for a government to shift rents toward its domestic market in industries with positive profits. Agriculture is hardly a high profit sector!

However, if governments frequently intervene in agricultural markets, and if one way they intervene is by creating state trading agencies, it is worth examining how these institutions affect the strategic use of policy. Marketing boards are common on both the export and import side of agricultural markets; for example, several major exporters of dairy products and grain sell through marketing boards, and major importers of grains, tobacco, and silk purchase through such boards (Hoos (1979), Kostecki (1982)). For OECD trade in 34 agricultural products for 1976, Kostecki (1982, pp. 26, 286-8) estimates 28

percent of exports and 27 percent of imports are accounted for by state trading.

It is also clear from the emphasis on agriculture in the current GATT negotiations that government use of trade policy in these markets is not trivial. Table 1 presents post-Tokyo Round trade weighted nominal tariff protection for 22 traded good sectors for the EEC, Japan, and the United States. Note that for the EEC and Japan, the agriculture, and food, beverage, and tobacco sectors are among the top four ranked sectors. A ranking of export subsidies by sector would be difficult (particularly given the prevalence of indirect subsidies in both manufacturing and agriculture); however, the GATT code regarding export subsidies is more lenient for primary products (other than minerals) than for non-primary products,[2] so that direct export subsidies are more prevalent in agriculture.

The models we examine are based on rivalry of marketing agents and governments of two countries exporting a homogeneous good, presumably agricultural, to a third country. In part, the motivation for the models is the widespread use of export subsidies in agriculture (World Bank (1986), Hillman (1978)) and the recent result of Brander-Spencer (1985) that in the presence of imperfect competition, export subsidies may be welfare improving for the country imposing them. It is well understood that producers (in our case, farmers) stand to gain if their governments increase their share of world markets, ceteris paribus. The question of interest in light of the Brander-Spencer analysis is whether export subsidies can be welfare improving given the type of imperfect competition that occurs in agricultural markets.

The models in this paper are similar to the Brander-Spencer export rivalry model (1985) in that marketing agents play a Nash quantity game given government policies, but the governments can precommit to these policies so as to give their agents a strategic advantage in world markets. There are, however, several important differences between their model and ours: (i) production and marketing in our model are carried out by different agents, and in one of our countries, the marketing agent maximizes joint producer returns rather than profits, (ii) there is domestic consumption in each exporting country, and governments can subsidize or tax domestic production and consumption as well as exports, and (iii) governments have the option of regulating prices charged to domestic consumers. The first and third of these are important because they are common characteristics of marketing boards and their regulation (Hoos (1979)), and the second is particularly important for any model of agricultural trade. For many products domestic consumption is a large portion of total sales, and government intervention in domestic agricultural markets is quite common (Brown (1986), Gardner (1986), Johnson (1973).

These features of our models are critical to the paper's contribution. A major theoretical contribution of our analysis is to show that even when a good is sold by two marketing agents, an export tax or free trade may be the optimal government policy when the marketing agent maximizes producer returns and is regulated in its domestic price policy. This differs from the Brander-Spencer result that a subsidy is optimal when two profit maximizing firms sell a homogeneous good in a third market. Our results differ from the existing ones in the agricultural economics literature in that we show circumstances in which a marketing board's government would optimally subsidize exports. The latter results hinge on our introducing rivalry into the analysis.

The second contribution of the paper concerns the optimal policy of the government in the country which privately markets the good. A quasi-competitive model of private marketing is constructed to show that when a marketing board and private trading industry with more than a few firms are rivals, it is unlikely that the government of the private trading country should subsidize exports.

Finally, we present evidence on the structure of world trade in wheat to indicate the relevance of the models presented.

1. Unregulated Marketing Board and Monopoly-Monopsony

Consider a world in which a homogeneous good is exported by two countries to a third country which does not produce it. Each of the exporting countries consumes the good, but because of restrictions outside the model, they do not import it. One such restriction could be transport cost, which, for simplicity is assumed to be zero here. The good is competitively produced, and producers sell to a distributor or marketing agent rather than directly to consumers. In practice this might occur because of technological features of transportation and marketing services, but, again, we abstract from these here. The competitive producer supply curve is upward sloping.

In each country there is a single marketing agent. In the home country it is a private monopolist and in the foreign exporting country it is a statutory marketing board. In both cases the agent handles all domestic, as well as foreign sales, to consumers. The essential difference between them is their objective functions. The home monopolist is assumed to maximize profits, while the foreign marketing board maximizes the joint returns of its competitive producers (farmers).[3] Given its objective, the marketing board does not exercise monopsony power, but in the absence of regulation, the monopolist does, since its marginal cost (outlay) for the good is higher than the competitive supply (producer) price.

Throughout the paper the assumptions about marketing agents comply with stylized facts from the world wheat market, which is the focus of the empirical analysis in Section 4. Empirical models of wheat trade often treat Canada and the United States as duopolists since, together, they export roughly 60 percent of world wheat exports. All Canadian sales of wheat are through the Canadian Wheat Board, while the United States exports are through private firms. In this section, we assume the private export industry is a domestic monopoly, but in Section 3 we consider a quasi-competitive export industry since the competitiveness of the United States grain export industry is disputed.

It should be noted that with only two marketing agents, there is no loss of generality in restricting the analysis to a marketing board-private firm rivalry. The policies which would be optimal for the government with a marketing board in this game would carry over (qualitatively) to a game with two marketing boards. The same is true for the government with a monopoly exporter.

As in Brander-Spencer (1985), the marketing agents are assumed to play a Nash quantity game in which they take as given the subsidies and/or taxes levied by their respective governments and the export sales of their rival. The exporting country governments can precommit to their policies, so that they play a Stackelberg game against the marketing agents and a Nash game against the rival government. Unlike Brander-Spencer, the governments have three policy instruments at their disposal: a consumption subsidy(tax), a production subsidy(tax), and an export subsidy(tax). All subsidies or taxes are specific. This allows us to compare optimal policies in this government game with those of Just, et.al.(1979). Throughout the paper the analysis is partial equilibrium.

Marketing Agent Equilibrium

Let lower case variables refer to home country variables and upper case to corresponding variables in the foreign exporting country. The home country monopolist maximizes profits given by

$$(1) \qquad \pi = [d(y) + r]y + [D_m(x + X) + s]x - [p(y + x) - v](y + x)$$

where y denotes domestic sales, x export sales, d(•) domestic inverse demand, p(•) the competitive home inverse supply (producer price), $D_m(\cdot)$ inverse demand for imports by the third country, and r,s, and v denote the home government consumption subsidy(tax), export subsidy(tax), and production subsidy(tax), respectively. A positive(negative) value for a policy denotes a subsidy(tax). The marketing board maximizes the joint returns of competitive producers in its country, given by

$$(2) \qquad \Pi = [D(Y) + R]Y + [D_m(x + X) + S]X - \int_0^{Y+X}[P(q) - V]dq \quad .$$

For simplicity let inverse demand and supply curves be linear and given by $d(y) = a - by$, $D(Y) = A - BY$, $p(\cdot) = f + k(y + x)$, $P(\cdot) = F + K(Y + X)$, and $D_m = a_m - b_m(x + X)$ where a, b, A, B, f, k, F, K, a_m, and b_m are positive. The linearity assumption is consistent with the bulk of empirically estimated agricultural demand and supply equations. Other functional forms would not alter the major points of the paper, although magnitudes of effects and assumptions required for uniqueness and stability of equilibria would differ.

First order conditions for the monopolist dictate that marginal revenue in each market equal marginal cost, and are given by

$$(3) \qquad \partial\pi/\partial y = a + r - 2by - f + v - 2k(x + y) = 0$$

$$(4) \qquad \partial\pi/\partial x = a_m + r - 2b_m x - b_m X - f + v - 2k(x + y) = 0.$$

Second order conditions are given by $-2(b + k) < 0$, $-2(b_m + k) < 0$, and $4(b + k)(b_m + k) - 4k^2 > 0$. First order conditions for the marketing board are given by

$$(5) \qquad \partial\Pi/\partial Y = A + R - 2BY - F + V - K(X + Y) = 0$$

$$(6) \qquad \partial\Pi/\partial X = a_m + S - 2b_m X - b_m x - F + V - K(X + Y) = 0,$$

with second order conditions $-(2B + K) < 0$, $-(2b_m + K) < 0$, and $(2B + K)(2b_m + K) - K^2 > 0$. As expected, the essential difference between the monopolist and marketing board's first order conditions is that the monopolist's marginal cost reflects its monopsony power while the board's marginal cost is the competitive supply price.

For given values of r, v, s, R, V, and S, equations (3) - (6) determine equilibrium consumption and exports of the two exporting countries. A convenient way to describe the equilibrium is in terms of the two reaction functions, $\phi(X)$ and $\Phi(x)$, which are derived by solving (3) and (5) for y and Y, substituting into (4) and (6), and solving for $x = \phi(X)$ and $X = \Phi(x)$. The reaction functions are

$$(7) \qquad \phi(X) = \frac{b(a_m - f + s + v) + k(a_m - a + s - r) - b_m(b + k)X}{2[b_m(b + k) + bk]}$$

$$(8) \qquad \Phi(x) = \frac{2B(a_m - F + S + V) + K(a_m - A + S - R) - b_m(2B + K)x}{2[b_m(2B + K) + BK]}$$

where $\phi'(\Phi(x))\Phi' < 1$ is assumed to insure uniqueness and stability of the equilibrium. Equilibrium values of exports are (x^*, X^*) such that $\phi(X^*) = x^*$ and $\Phi(x^*) = X^*$, and y^* and Y^* are given by (3) and (5) evaluated at x^* and X^*.

Government Policy Choices

Following Just et.al., we measure each country's welfare by the sum of domestic consumer and producer surplus and net government revenue. Home country welfare is given by

$$(9) \qquad \begin{aligned} w = &\int_0^y [a - bq + r]dq - \int_0^{y+x} [f + kq - v]dq \\ &+ [a_m - b_m(x + X) + s]x - ry - v(x + y) - sx. \end{aligned}$$

Recalling that each government plays Stackelberg against marketing agents and Nash against the rival government, the home government is assumed to choose r, v, and s in order to maximize (9) given the behavior of agents and fixed foreign policies. First order conditions for the home government are $\partial w/\partial \tau = 0$ for $\tau =$ r, v, and s where

$$(10) \qquad \begin{aligned} \partial w/\partial \tau = &[a - by^*](\partial y^*/\partial \tau) \\ &- [f + k(y^* + x^*)][(\partial y^*/\partial \tau) + (\partial x^*/\partial \tau)] \\ &+ [a_m - 2b_m x^* - b_m X^*](\partial x^*/\partial \tau) - b_m x^* \partial X^*/\partial \tau \end{aligned}$$

Using the monopolist's first order conditions, $\partial w/\partial \tau$ can be written as

$$(11) \qquad \begin{aligned} \partial w/\partial \tau = &[k(y^* + x^*) - v][(\partial y^*/\partial \tau) + (\partial x^*/\partial \tau)] + \\ &[by^* - r][\partial y^*/\partial \tau] - [s(\partial x^*/\partial \tau) + b_m x^*(\partial X^*/\partial \tau)] \end{aligned}$$

Welfare is maximized for the following choices of r, v, and s

$$(12) \qquad r = by^* > 0$$

$$(13) \qquad v = k(y^* + x^*) > 0$$

$$(14) \qquad s = -b_m x^*(\partial X^*/\partial \tau)/(\partial x^*/\partial \tau) > 0$$

where $(\partial X^*/\partial \tau)/(\partial x^*/\partial \tau) = -b_m(2B + K)/[2(b_m(2B + K) + BK)] = \Phi'(\cdot)$ for any $\tau =$ r, v, and s.[4]

While these choices of r, v, and s are not unique, they are the only choices of the three consistent with offsetting each distortion in the model at its source. Any other choices would necessitate targeting the export policy partially toward either the domestic consumption or production distortion.[5] Hence we follow Just et. al. in assuming that each policy is chosen to exactly offset the distortion at its source. To see that this is possible, notice that v, the production subsidy, enters both first order conditions for the home

exporter. If v is chosen according to (13), the two first order conditions are separated; and the consumption subsidy can be used to offset the domestic consumption distortion, while the export subsidy can be used to exercise market power abroad.

The foreign country's welfare, W, is given by an equation analogous to (9) with the appropriate subsitution of upper case letters. That government chooses R, V, and S to maximize welfare given the behavior of marketing agents and fixed home country policies. Differentiating W with respect to τ = R, S, and V and substituting from the marketing board's first order conditions, the first order conditions for the foreign exporting government can be written as

$$(15) \quad \partial W/\partial\tau = -V[(\partial Y^*/\partial\tau) + (\partial X^*/\partial t)] + [BY^* - R](\partial Y^*/\partial\tau) - [S(\partial X^*/\partial\tau) + b_m X^*(\partial x^*/\partial\tau)] = 0 \quad .$$

Welfare is maximized for

$$(16) \quad R = BY^* > 0$$

$$(17) \quad V = 0$$

$$(18) \quad S = -b_m X^* (\partial x^*/\partial\tau)/(\partial X^*/\partial\tau) > 0$$

where $(\partial x^*/\partial\tau)/(\partial X^*/\partial\tau) = -b_m(b + k)/2[b_m(b + k) + bk] = \phi'(\cdot)$ for τ = R, V, and S. We maintain the assumption that policies are determined to exactly offset distortions at their source.

The Nash equilibrium for the government policy game is characterized by the first order conditions for the monopolist and the marketing board, (3) - (6), and equations (12) - (14) and (16) - (18). The governments' domestic policies are similar to those of Just et.al., and the export subsidies are positive as in the Brander-Spencer model without domestic consumption or a marketing board. This is not surprising since we have targeted policies so that export policy need not be adjusted to offset domestic distortions. Domestic policies are determined completely by domestic distortions, so that the optimal policies are no different in our model with export rivalry than in Just et.al.'s nonstrategic environment. The government of the country with an unregulated monopoly-monopsonist will subsidize domestic consumption and production, and the government of the country with a marketing board need not subsidize production but will subsidize consumption.

The difference in our export policy and Just et.al.'s comes from the export rivalry. In Just et.al's analysis, a single marketing agent supplies the world market. Given the ability to price discriminate, this marketing agent exports the socially optimal quantity. With a Cournot export rivalry, however, each agent's exports are a function of its rival's exports. A government with the ability to precommit to an export subsidy can use that fact to improve its country's welfare, ceteris paribus. Any marketing agent (marketing board or monopolist) will export more with an export subsidy than it would otherwise. This reduces the the exports of the foreign rival in equilibrium, hence increasing domestic welfare via an increase in the marketing agent's profits. This is a key feature missing in the Just et.al. analysis.

2. Regulated Marketing Board and Monopoly-Monopsony

The literature on strategic trade policy has focused on the impact of governments being able to precommit to tax/subsidy policies. But governments precommit to more than simple tax/subsidy policies. The market structures they permit and their regulation of industry involve a precommitment! In the previous section, we showed that a government precommiting to a statutory

marketing board (in order to eliminate potential exercise of monopsony power against producers) did not affect the policy prescriptions for strategic use of trade policy. In this section, we show that this result is altered when the government with a marketing board regulates the domestic pricing of the board. There are two reasons for doing this. One is to show that regulating the board in the hope of eliminating the need for a consumption subsidy is not as innocuous as it might seem. The second reason is that it is not uncommon for governments to impose such rules on their marketing boards (Hoos (1979)).

Consider a game identical to the one in the previous section, with the exception that the marketing board maximizes joint returns of its competitive producers subject to the constraint that domestic inverse demand equals inverse supply [i.e. $D(Y) + R = P(Y + X) - V$]. The regulated marketing board's first order conditions are

$$A + R - BY - F + V - K(Y + X) = 0 \tag{19}$$

$$a_m + S - 2b_mX - b_mx - F + V - K(X + Y) + KBY/(B + K) = 0 \tag{20}$$

where use has been made of the constraint in obtaining equation (20). Notice the regulation prevents the marketing board from equating marginal revenue in each market with marginal cost. Moreover, the last term in (20) implies the board will export more than it would in the absence of regulation.

The regulated board's reaction function is derived by solving (19) for Y, substituting into (20), and solving for $X = \Psi(x)$ given by

$$\Psi(x) = (\eta + \mu - \lambda x)/\sigma \tag{21}$$

where $\eta = B(B + 2K)(a_m + S - F + V)$,

$\mu = K^2(a_m + S - A - R)$,

$\lambda = b_m(B + K)^2$, and

$\sigma = 2b_m(B + K)^2 + BK(B + 2K)$.

For given values of r, v, s, R, V, and S, equations (3), (4), (19), and (20) determine equilibrium consumption and exports of the two exporting countries when the marketing board is regulated. Equilibrium exports in this game are given by $(x^{\#}, X^{\#})$ such that $\phi(X^{\#}) = x^{\#}$ and $\Psi(x^{\#}) = X^{\#}$, and equilibrium values of $y^{\#}$ and $Y^{\#}$ are given by (3) and (19) evaluated at $x^{\#}$ and $X^{\#}$. $\phi'(\Psi(X))\Psi' < 1$ is assumed to insure uniqueness and stability of the equilibrium.

To determine optimal policies for the foreign exporting government, we differentiate W with respect to τ = R, V, and S and substitute the modified first order conditions, (19) and (20) to obtain

$$\partial W/\partial\tau = -V[(\partial Y^{\#}/\partial\tau) + (\partial X^{\#}/\partial\tau)] - R(\partial Y^{\#}/\partial\tau) - [S + KBY^{\#}/(B + K)](\partial X^{\#}/\partial\tau) - b_mX^{\#}(\partial x^{\#}/\partial\tau) \tag{22}$$

Welfare maximizing policy choices are

(23) $R = V = 0$, and

(24) $S = -KBY^{\#}/(B + K) - b_m X^{\#}(\partial x^{\#}/\partial \tau)/(\partial X^{\#}/\partial \tau)$

where $(\partial x^{\#}/\partial \tau)/(\partial X^{\#}/\partial \tau) = \phi'(\cdot)$ is independent of the policy tool.

The equilibrium for this policy game is characterized by the first order conditions for the monopolist and the regulated marketing board, (3), (4), (19), and (20), and equations (23), (24), (12) - (14) evaluated at $x^{\#}$, $y^{\#}$, and $X^{\#}$. Qualitatively, the home government policies are not affected by whether or not the board is regulated. However, the optimal trade policy of the foreign exporting government becomes ambiguous when it substitutes domestic price regulation for a consumption subsidy. The optimal policy is a tax if the first term in S dominates, and a subsidy if the second term dominates. The reason that a tax might be appropriate is most easily seen in Just et. al.'s nonstrategic case. In their model a regulated marketing board would export too much from society's point of view unless it were taxed. This occurs because at the socially optimal level of exports the board could purchase an extra unit of the good at the competitive supply price, increase its domestic price by the increase in the supply price, and sell the extra unit plus the reduction in domestic consumption abroad. The first term in (24) reflects the fact that for a given level of home exports, the regulated board will export too much, while the second term reflects the effect of the board's exports on home country exports in equilibrium.

3. Quasi-Competitive Home Market

It is well known that optimal policy in oligopolistic trade models is sensitive to the number of firms (Dixit (1984), Salant (1984), Krugman (1987), Cooper and Riezman (1986)), and it is natural to expect the same to be true here. The statutory marketing board is a clear barrier to entry in the foreign exporting country, but unless barriers to entry are prohibitive in the home country we might expect more than one marketing agent even if there are economies of scale in distribution. For that reason we examine a quasi-competitive model for the home country.

This exercise is motivated largely because the competitiveness of the U.S. agricultural marketing system has been a controversial issue. In the mid 70's some sources claimed that the market was essentially monopolistic/monopsonistic, and in response, several government, academic, and private studies have examined the issue empirically. As will be seen in Section 4, even if the U.S. agricultural marketing system is not purely competitive, it is clearly not a pure monopoly-monopsony. For that reason, it is important to know how sensitive the policy choices are to the number of firms in the home country.

The simplest way to do this would be to increase the number of firms in the previous two games. A more general model and one consistent (in a stylized fashion) with the example of U.S. wheat trade presented in Section 4 is one which allows two types of home firms: one which exports and one which only markets domestically because of a cost disadvantage. In the limit the model allows the possibility of imperfect competition in the export sector, but the inability of exporting firms to exercise monopsony power in the domestic market because of competition with firms marketing the good domestically. In this section we examine optimal policy when the home market is modified to allow for this possibility.

Suppose export marketing involves a distribution cost in addition to the producer price of the good. We abstract from whether this is a transport or information-related cost, and for simplicity we assume it is constant per unit sold. There are $n + h$ firms, the last h of which have a cost disadvantage

relative the the first n firms. Distribution cost, per se, in the domestic market remains zero. Profit for the ith firm is given by

$$(25) \qquad \pi_i = [a + r - b(y_i + \bar{y}_i)]y_i + [a_m + s - b_m(x_i + \bar{x}_i + X)]x_i$$

$$- [f - v + k(x_i + \bar{x}_i + y_i + \bar{y}_i)](y_i + x_i) - c_i x_i$$

where $\bar{y}_i = \sum_{j \neq i} y_j$ and $\bar{x}_i = \sum_{j \neq i} x_j$ and c_i is per unit export distribution cost. Firms are differentiated only by this cost parameter, which for simplicity we assume to be low, c_1, or high, c_2. For $i = 1,\ldots,n$, $c_i = c_1$, $y_i = y_1$ and $x_i = x_1$; and for $i = n + 1,\ldots,n + h$, $c_i = c_2$, $y_i = y_2$ and $x_i = x_2$.

For high enough values of c_2, $x_2 = 0$, and the relevant first order conditions are

$$(26) \qquad \partial\pi_1/\partial y_1 = a + r - (n + 1)by_1 - hby_2 - f + v - k(n + 1)(y_1 + x_1) - hky_2 = 0,$$

$$(27) \qquad \partial\pi_2/\partial y_2 = a + r - (h + 1)by_2 - nby_1 - f + v - k(h + 1)y_2 - nk(y_1 + x_1) = 0, \text{ and}$$

$$(28) \qquad \partial\pi_1/\partial x_1 = a_m + s - (n + 1)b_m x_1 - b_m X - f + v - k(n + 1)(x_1 + y_1) - hky_2 - c_1 = 0.$$

The reaction function for a home exporter in this model is derived by solving (26) and (27) for y_1, substituting into (28), and solving for $x_1 = \phi_1(X)$. Since exporting firms are symmetric, the reaction function for the home country export sector is $n\phi_1(X)$ where

$$(29) \qquad \phi_1(X) = (\alpha + \beta - \gamma X)/\delta$$

where $\alpha = b(a_m - f + s + v - c_1)$,

$\beta = k(a_m - a + s - r - c_1)$,

$\gamma = b_m(b + k)$, and

$\delta = (n + 1)[b_m(b + k) + bk]/n$.

Notice that $\phi_1(X)$ differs from $\phi(X)$ only by the subtraction of $c_1(b + k)$ in the numerator and replacement of the number 2 in the denominator by $(n + 1)/n$. Domestic consumption in the home country is $ny_1 + hy_2$ where

$$(30) \qquad y_1 = y_2 - kx_1/(b + k).$$

As we might expect, each exporter sells less at home than a typical domestic marketing firm.

As before, the marketing board's reaction function will depend on whether or not it is regulated. Denoting the marketing board's cost to distributing exports by C, its reaction function if it is unregulated is given by subtracting C(2B + K) from the numerator of the expression for $\Phi(x)$ in equation (8). If the board is regulated, its reaction function is given by subtracting $C[B(B + 2K) + K^2]$ from the numerator of the expression for $\Psi(x)$ in equation (21). Notice that because of the way C enters, it does not affect the slope of either marketing board's reaction function.

As before, optimal policies for each government are derived by differentiating the expressions for welfare with respect to policies and substituting from the relevant first order conditions. The expressions for welfare differ from those in Section 3 by the subtraction of the distribution cost multiplied by exports. The equilibrium for a game between the home government and the unregulated board is now characterized by (29) and the reaction function for the unregulated marketing board incorporating C and the following policies:

$$r = by_1^{**}, \tag{31}$$

$$v = k(y_1^{**} + x_1^{**}), \tag{32}$$

$$s = -b_m x_1^{**}(n[1 + \Phi'(\cdot)] - 1), \tag{33}$$

$$R = BY^{**}, \tag{34}$$

$$V = 0, \text{ and} \tag{35}$$

$$S = -b_m X^{**} n\phi_1'(\cdot) \tag{36}$$

where superscript ** denotes equilibrium values for this game.

Table 2 presents these policies and the policies from the previous games. Notice that qualitatively the foreign exporting government's policies are unaffected by the modification of home market structure. Subsidizing both domestic consumption and exports remains optimal. The home government continues to subsidize both domestic consumption and production, but the optimal export policy is now ambiguous. It is a subsidy, free trade, or a tax as n is less than, equal to, or greater than $1/(1 + \Phi'(\cdot))$. Since $\Phi'(\cdot)$ is independent of any choice variable this result is independent of the foreign government subsidy or tax policy. In fact, since $\Phi'(\cdot) \in (-.5, 0)$, the existence of two home exporting firms is sufficient for a tax to be optimal.

Now consider the game with $n > 1$ home firms and a regulated marketing board. The policy equilibrium is described by (29) and the regulated marketing board reaction function incorporating C and the following policies:

$$r = by_1^{\#\#}, \tag{37}$$

$$v = k(y_1^{\#\#} + x_1^{\#\#}), \tag{38}$$

$$(39) \qquad s = -b_m x_1^{\#\#}(n[1 + \Psi'(\cdot)] - 1),$$

$$(40) \qquad R = V = 0, \text{ and}$$

$$(41) \qquad S = -b_m X^{\#\#} n\phi_1'(\cdot) - KBY^{\#\#}/(B + K)$$

where superscript ## denotes equilibrium values for this game.

Again two exporting firms are enough for an optimal export tax at home. And as before, the invariance of the slope of the board's reaction function with respect to choice variables makes this result independent of foreign policy. As shown in Table 2, optimal foreign policies are qualitatively the same as those for the regulated board with a home country monopoly-monopsony. Essentially the regulation of domestic price gives the board extra incentive to export, so that the optimal export policy is either a lower subsidy than in the unregulated case or a tax.

4. World Wheat Trade, State Trading, and Market Structure

Each of the four models examined is characterized by the rivalry of two exporting countries with market power in international trade, where one of the countries exercises its power, in part, through a marketing board. Hence these models would apply to markets dominated by a few countries, at least one of which sells through a marketing board. One such market is the world wheat market. The combined exports of the two largest exporting countries, Canada and the United States, comprise roughly 60 percent of world exports. The combined market share of the top four exporters is approximately 80 percent.[6]

Table 3 gives an indication of the portion of world wheat exports which was either sold or purchased by marketing or state trading agencies for selected periods between 1963 and 1984.[7] The table includes exports of the United States, Canada, EEC, Australia, Argentina, and U.S.S.R.. Exports of the United States and EEC are private, and after 1963-67 Argentina's exports are private. Canada and Australia sell through marketing boards. The EEC is the only major importer which is private since the Western European countries other than the EEC have state trading agencies for wheat, and the Japanese import through the Japanese Food Agency. Although their market shares are variable, the U.S.S.R. and Peoples Republic of China are large importers.

Note that less than six percent of the exports in Table 3 is sold by private traders to private traders. This trade is primarily United States exports to the EEC, and has been declining over time. Percentages in the second row indicate that over half of the exports are sold by private traders to state importers. These percentages reflect mainly United States and EEC exports. Rows three and four indicate the exports of state exporters by their destination. Note that the sum of these (given in row six) is roughly a third of total exports. Finally, the sum of imports by state traders ranges between 86 and 96 percent.

Imperfectly Competitive Models of World Wheat Trade

Market shares for the major wheat exporters have remained fairly stable over the past twenty years, with the exception that the EEC share of world exports has roughly doubled in the last decade. Because of the large and stable export shares, a number of studies have examined oligopolistic models of the world wheat market (McCalla (1966), Taplin (1969), Alaouze, Watson, and Sturgess (1978), Schmitz, McCalla, Mitchell, and Carter (1981), Karp and McCalla (1983), Paarlberg and Abbott (1984), and Kolstad and Burris (1986)). These studies have made a variety of assumptions about numbers of rivals and the nature of competition among them.

Perhaps the closest to the models developed here is that of Kolstad and Burris (1986) which is a spatial equilibrium trade model in which producing country governments are Nash quantity competitors who maximize profits and have the ability to price discriminate between domestic and foreign sales. For 1972-73 trade flows, they examine hypotheses of (i) a U.S.-Canada duopoly, (ii) a U.S.-Canada-Australia triopoly, (iii) a Japan-EEC duopsony, and (iv) perfect competition. They find that the U.S.-Canadian duopoly comes the closest to predicting actual trade for that year.[8]

These results suggest a game between the U.S. and Canadian governments with sales agents being the Canadian Wheat Board and U.S. grain exporters is a useful abstraction. One of the major goals of the Canadian Wheat Board is to maximize producer returns, and it is the sole agent for both domestic and foreign sales of Canadian wheat. Since September, 1973, the price it can charge domestically has been regulated (Schmitz and McCalla (1979)), so that its behavior comes closest to the regulated board in our models. The remaining issue as to which of the models would apply to a Canadian-U.S. duopoly concerns the competitiveness of the U.S. marketing system.

Competitiveness of U.S. Grain Marketing

A 1976 report of USDA's Farmer Cooperative Service claimed that the largest six grain exporting firms accounted for 90 percent of U.S. exports of grain (USGAO, 1982). Estimates of concentration in U.S. grain exporting plus the controversial sales of grain to the U.S.S.R. in the mid-70s stimulated a series of studies of the competitiveness of this sector.

Several of these were done by the General Accounting Office of the U.S. government. They focused on providing revised estimates of concentration in the export sector (USGAO (1982), Conklin (1982)) and on the efficiency of futures markets for grains (Conklin (1982)). Table 4 presents GAO's estimates of concentration ratios for wheat, corn, soybeans, and all grains. Since many of the same firms that export wheat also trade other grains, we present evidence for other grains, as well. Three characteristics are evident. First, the export sector is not as concentrated as the 1976 estimate suggests. The largest four exporters account for 61 percent of export sales for wheat, and one must include the largest twenty firms to account for 90 percent of export sales. Second, the concentration ratios for corn, soybeans, and all grains are lower than for wheat. Finally, concentration ratios for domestic sales are lower still. Caves and Pugel (1982) present similar evidence based on a survey of members of the North American Export Grain Association. Their evidence points to the largest firms handling a majority of "direct" export sales, while many smaller firms purchase grain from farmers to sell domestically or to the largest exporters who then export it (the latter type of sale being classified as "indirect" exports).

High concentration ratios are not necessarily indicative of the exercise of market power. In the short run, firms in a highly concentrated industry have the potential to exercise market power until entry can occur. While the grain

export industry is highly concentrated, there has been considerable entry and exit in the industry over the last decade. The number of firms reporting export sales of wheat increased forty percent between marketing year 1974/75 and 1983/84, and the number of firms exporting corn and soybeans increased thirty percent over the same period.[9] As reported in Caves and Pugel (1982), one of the largest firms exited the industry during that period (Cook).

Evidence of price discrimination by exporting firms in the absence of government subsidies would be indicative of market power. Except in the limiting case ($n = h = \infty$) of the quasi-competitive model, the analysis in this paper assumes firms have the ability to price discriminate between the home and foreign market. Although the difference between the export and domestic consumer price in any of the models may be positive or negative, all of the models predict a positive correlation between this difference and export volume for zero or constant distribution cost per unit. With perfect competition and constant distribution cost, export volume and this price difference are unrelated. It is, therefore, possible to test for market power and the ability to price discriminate by testing for a positive relation between export volume and the difference between export and domestic prices.

To prove ability to price discriminate, data for export and wholesale prices for the same type and grade of exports, net of distribution costs are necessary. We have export and wholesale prices for the same grade of wheat for hard red winter (hrw) and dark northern spring (dns) wheat for 1962/63 - 1983/84. Export and wholesale price data for the same period are also available for corn and soybeans.[10] Unfortunately data for distribution cost are not available, so that any analysis of the relation between the export-wholesale price differential and export volume must be interpreted in light of potential effects this cost might have. For example, it would be possible in the framework of the models presented here for the export-domestic consumer price difference to be negatively correlated if there were significant economies of scale in distribution. Caves and Pugel (1982) present evidence of such economies of scale in distribution as part of their explanation for the high concentration of the U.S. grain export industry.

Table 5 presents the results of eight regressions of the export-wholesale price differential on export volume. The first four columns describe the results for the period 1962/63 - 1983/84. Column labels denote the commodity for which the price differential is the dependent variable. All data are yearly and prices are in real terms. Because the price differential could be affected by shifts in underlying consumer demand and producer supply or changes in distribution cost, we include time as a regressor to capture any systemmatic changes in these excluded variables. Since the relation between the price differential and export volume can be affected by economies of scale in distribution and export volume has grown over time, we also include time multiplied by export volume. Finally, for the years 1962/63 -1972/73, the United States subsidized wheat exports, so that we include a dummy equal to one in the subsidy years and zero in non-subsidy years. Neither corn nor soybeans were subsidized; however, corn exports showed a dramatic shift in 1972/3, so that a dummy equal to one is included for that and subsequent years.

With the exception of wheat, the explanatory power of these regressions is low. Moreover, the wheat regressions are consistent with the export subsidy being the major determinant of any price differential. The wheat subsidy dummy is the only variable significant at the five percent level in any of the regressions. Export volume and trend*volume are significant at the ten percent level only in the case of dns wheat.

The last four columns in Table 5 refer to results of a slightly different regression for the period 1974/5 - 1983/84. For each of the years in the period, data are available for the number of firms reporting export sales. For the same reasons that concentration ratios are a poor measure of market power,

the number of firms need not be indicative of either the presence or absence of market power. Nonetheless, there was substantial entry during this period, so that we include the number of firms as a regressor. If the industry were purely competitive there should be no relation between the price differential and the number of firms. The dummy variables are not applicable to this period.[11]

Notice first the marked difference between the explanatory power of the wheat regressions and those for the other grains. While the coefficient of export volume is positive in all cases, it is significant at the five percent level only for wheat (the significance level for corn is 21 percent). Recalling that the four-firm concentration ratio for wheat is noticeably higher than that for the other two, these results are at least suggestive of the exercise of market power in wheat. In none of the regressions, however, is the coefficient for the number of firms significant.

For both types of wheat, volume, trend, and trend*volume are significant at the five percent level. Note that because we include trend*volume, the partial effects of volume and trend are functions of both their coefficients and the coefficient of trend*volume. Thus for the wheat regressions, we report the partial effects of volume and time for each year in Table 6. As expected, in the regressions for 1962/63 - 1983/84 the partial effects are rarely significant. For 1974/5-1983/4, however, the partial effects of volume and trend are often significant. For both types of wheat, the partial effect of volume on the price differential is positive until the late 70's and becomes negative in the 80's. The partial effect of trend on the differential goes from positive to negative in the case of hrw wheat, while it is consistently negative for dns wheat.

There are a number of interpretations we could give to the volume and trend results for 1974/75-1983/84. One interpretation is that exporting firms have market power and that the trend term reflects economies of scale in distribution. If economies of scale became more important toward the end of the period, the partial effect of volume would become negative over time. Another interpretation is that the industry is relatively competitive, with entry occurring over the period in response to short run profits of the mid-seventies. The latter interpretation is consistent with evidence of Caves (1978), who found a significant relation between profit margins and volume of sales for all grains for the year 1973/74. For a more extended period, he found a significant relation only for soybeans.

In summary, the evidence presented here is consistent with that of others (Caves (1978), Caves and Pugel (1982), Conklin (1982), and USGAO (1982)). Grain exporting is highly concentrated because of economies of scale in distribution, but barriers to entry in U.S. grain marketing are not prohibitive. Large exporting firms may be in a position to exercise market power in the short run, and they may have done so in the mid-70's. Nonetheless, the industry cannot be characterized as a pure monopoly-monopsony.

This result is important in light of our results in Section 3. The optimal trade policy for the home government changes from an export subsidy with monopoly-monopsony to an export tax with two exporting firms. Whether or not U.S. exporting firms have market power, it appears that the appropriate government policy to maximize social welfare would be an export tax.

5. Concluding Remarks

In this paper we examined several theoretical models capable of showing how state trading and competition in private export trade affect strategic use of trade policy. Recent literature in this area has focused on oligopolistic industries in which private firms maximize profits and are unregulated. In our analysis, if domestic tax/subsidy policy can be used in conjunction with trade policy, optimal trade policy is qualitatively the same whether an export agent

maximizes producer returns or profits. If, however, governments regulate domestic consumer prices, appropriate trade policy may be quite different depending on the marketing agent's objective.[12] We find that the exports of a regulated marketing board might be optimally taxed by its government, whereas a government would optimally subsidize exports of a monopolist exporter.

We also find that when a marketing board and a private export industry composed of one or more firms compete as Cournot rivals, the government of the country with the private industry would subsidize exports only when marketing is done by a monopolist. In light of this result, our empirical analysis of the United States grain industry suggests export subsidies would not be welfare improving from a national point of view. Based on the ability of exporters to price discriminate between domestic and export sales, we find no evidence of the exercise of market power in corn and soybean markets. For the period 1974/75-1983/84, we find limited support for price discrimination in wheat markets. Nonetheless, during this period at least 41 firms recorded export sales of wheat, so that the policy prescription of the theoretical model for this case would be an export tax.

Several issues not addressed here are potentially interesting. First, the importing country in these models also has market power. Brander and Spencer (1984, 1985) have examined optimal policy of an importing country in the face of imperfect competition. Our evidence for wheat trade suggests two ways optimal import policy might be approached. Since over 80 percent of wheat imports is purchased by state traders (recall Table 3), it would be interesting to examine how the objective of the state importing agency affects policies and market outcomes. The other interesting approach would be to allow the importer to produce (and perhaps export) the good. The motivation for this complication comes from the prominent role of the EEC in agricultural markets and trade negotiations. Carter and Schmitz (1979) have examined the EEC's variable levy as an optimal tariff, but it is clear that EEC intervention in agricultural markets comes from more than a simple optimum tariff calculation (Brown (1986), Gardner (1986), Hayes and Schmitz (1986), and Sarris (1986)).

Finally, in our models the marketing board maximized joint producer returns and its government maximized social welfare. In practice, marketing boards and governments also have price stability goals. Since it is well known that policy implications in strategic models are sensitive to whether rivals compete in output or price (Eaton and Grossman (1986)), we expect policies would differ if agents competed in prices and if objectives pertained to stability of these prices.

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1 McCalla and Schmitz (1982) and studies in McCalla and Josling (1981) argue that market outcomes will vary depending on the source of the imperfect competition.

2 Export subsidies for primary products are to be avoided when they lead to a more than "equitable" share of the market, whereas countries are not to grant subsidies (either direct or indirect) which lead to export prices below domestic prices in the case of non-primary products.

3 See Markusen (1984) for an analysis of marketing boards which maximize profits.

4 As shown by Dixit (1984), this choice is equivalent to the government choosing domestic and export sales to maximize welfare. To see this, substitute r, v, and s given by (12)-(14) into (3) and (4). The monopolist's first order conditions are then equivalent to those which would emerge if the government were to choose x and y to maximize (9)

$$\partial w/\partial y = a - by - f - k(y + x) = 0$$

$$\partial w/\partial x = a_m - 2b_m x - b_m[\Phi(x) + x\Phi'(x)] - f - k(y + x) = 0.$$

5 It is, of course, also possible to employ only a production and consumption subsidy/tax, but exposition would be more difficult.

6 These percentages were calculated from data in International Wheat Council, International Wheat Statistics, and may be off by +/- 2 or 3 percent in any year. Nevertheless, the market shares have been relatively stable over the past twenty years.

7 See McCalla and Schmitz (1982), Appendix 3, pp. 291-293, for a list of state trading boards and agencies.

8 Essentially there are more nonzero bilateral trade flows for wheat than a perfectly competitive spatial equilibrium model would predict. An alternative approach to predicting these flows would be to treat wheat as a differentiated product (Johnson, Grennes, and Thursby (1979)).

9 Information was provided by the Export Sales Reporting Division of the Foreign Agricultural Service. In marketing year 1974/75 there were 41 firms reporting exports of wheat, 56 firms reporting corn exports, and 39, soybean exports. In 1983/84 there were 61 firms reporting exports of wheat, 76 firms reporting corn exports, and 53, reporting soybean exports.

10 Data for wheat are available by protein content, while price data are available only for #2 yellow corn and #1 yellow soybeans. The difference lies in the fact that, strictly speaking, wheat is not homogeneous and is demanded for different end uses, while corn and soybeans are not. See Johnson, et. al. (1979) on this point.

11 It can be argued that credit policies are effective subsidies, but neither our models nor our empirical work incorporate these.

12 If the private monopolist, for example, were regulated in the same manner, a higher export subsidy than otherwise would be optimal.

Table 1

Nominal Tariff Protection-Post Tokyo Round(1976)

by Sector (Percent: Weighted by Own Country Imports)

Industry	ISIC	EEC		Japan		U.S.	
		Level	Rank	Level	Rank	Level	Rank
Agr, For,&Fish	1	4.86	12	18.4	2	1.80	17
Food, Bev, & Tob	310	10.1	3	25.4	1	4.70	7
Textiles	321	7.17	8	3.30	12	9.20	2
Wearing Apparel	322	13.4	1	13.8	4	22.7	1
Leather Prod.	323	2.01	21	3.00	13	4.20	9
Footwear	324	11.6	2	15.7	3	8.80	3
Wood Prod.	331	2.51	18	0.30	21	1.70	18
Furn & Fixt.	332	5.60	9	5.10	7	4.10	11
Paper & Ppr Prod.	341	5.37	11	2.10	16	0.20	22
Print & Publ.	342	2.06	20	0.10	22	0.70	21
Chemicals	35A	7.95	5	4.80	8	2.40	16
Petrol & Rel Prod.	35B	1.16	22	2.20	15	1.40	19
Rubber Prod.	355	3.54	17	1.10	18	2.50	14
Nonmetal. Min Prod.	36A	3.66	16	0.50	20	5.30	5
Glass & Glass Prod.	362	7.70	7	5.10	6	6.20	4
Iron & Steel	371	4.67	14	2.80	14	3.60	12
Nonferrous Metals	372	2.13	19	1.10	19	0.70	20
Metal Prod.	381	5.46	10	5.20	5	4.80	6
Nonelec Prod.	382	4.37	15	4.40	10	3.30	13
Elec Mach.	383	7.89	6	4.30	11	4.40	8
Transp Equip.	384	7.95	4	1.50	17	2.50	15
Misc Manuf.	38A	4.67	13	4.60	9	4.20	10
AVERAGE		6.09		8.28		3.59	

SOURCE: Based on information in tables 5.7 - 5.9 of Deardorff, A.V. and R.M. Stern, The Michigan Model of World Production and Trade. Cambridge: MIT Press, 1986

Table 2

Optimal Government Policy

Foreign Exporter	Unregulated Marketing Board		Regulated Marketing Board	
Home Exporter				
Monopoly-	r>0	R>0	r>0	R=V=0
Monopsony	v>0	V=0	v>0	
	s>0	S>0	s>0	$S \gtrless 0$
Quasi-	r>0	R>0	r>0	R=V=0
Competitive	v>0	V=0	v>0	
	$s \gtrless 0$	S>0	$s \gtrless 0$	$S \gtrless 0$

Lower case letters denote home government policies and upper case, foreign.

r >0 (<0) denotes specific consumption subsidy (tax).

v >0 (<0) denotes specific production subsidy (tax).

s >0 (<0) denotes specific export subsidy (tax).

Table 3

State Trading in Wheat -- percentage of volume of principal exporters accounted for by state traders

	1963-67 percent	1973-77 percent	1980-84 percent
1. Private Exporters to Private Importers	5.9	4.4	2.2
2. Private Exporters to State Importers	51.2	56.6	64.1
3. State Exporters to Private Importers	8.1	4.3	2.2
4. State Exporters to State Importers	34.8	34.7	31.6
5. Exports by Private Traders =(1+2)	57.1	61.0	66.3
6. Exports by State Traders =(3+4)	42.9	39.0	33.8
7. Imports by Private Traders =(1+3)	14.0	8.7	4.4
8. Imports by State Traders =(2+4)	86.0	91.3	95.7
Volume of Trade (000 mt)	49,891	60,385	93,339
Total Exports (000 mt)	56,397	63,506	97,839

SOURCE: For 1963-1977 data from Table 3.5 of "State Trading in Grain", McCalla, A. and Schmitz, StateTrading in International Markets, edited by M.M. Kostecki. New York: St. Martin's Press, 1982.
For 1980-84 percentages calculated from International Wheat Council, World Wheat Statistics, various issues.

Table 4

Concentration Ratios for U.S. Grain Sales

	Export Sales (Marketing Year 1974/5)				Wholesale Sales (Calendar Year 1977
Number of Firms	Wheat	Corn	Soybeans	All Grains	All Grains
Four Largest	61.0%	42.0%	40.5%	48.6%	25.4%
Eight Largest	81.7%	63.8%	63.7%	68.6%	38.1%
Twenty Largest	89.2%	93.3%	90.8%	90.1%	54.5%

Source: Conklin, N.C., An Economic Analysis of the Pricing Efficiency and Marketing Organization of the U.S. Grain Export System. U.S. General Accounting Office, Staff Study GAO/CED 82-61S; June 15, 1982, pp. 30, 31, 33.

Table 5

U.S. Export-Wholesale Price Differential

Variables	1962/3-1983/4				1974/5-1983/4			
	Wheat (hrw)	Wheat (dns)	Corn	Soybeans	Wheat (hrw)	Wheat (dns)	Corn	Soybeans
Constant	-0.201 (-.60)	-0.309 (-.944)	-.167 (-.65)	.338 (.46)	-0.924** (-6.55)	-0.577** (-3.47)	-1.284 (-1.67)	1.44 (.34)
Volume	0.025 (.76)	0.058* (1.81)	.0004 (1.01)	.0002 (.08)	0.093** (5.41)	0.053** (2.61)	.0004 (1.44)	.001 (.30)
Trend	0.014 (.70)	0.033 (1.66)	.013 (.55)	-.045 (-.61)	0.153** (6.55)	0.082** (2.99)	.129 (1.35)	.247 (.72)
Trend*Volume	-0.001 (-.56)	-0.003* (-1.83)	-.000 (-.58)	.000 (.27)	-0.013** (-7.05)	-0.009** (-4.39)	-.000 (-1.87)	-.0002 (-.24)
Number Firms	N/A	N/A	N/A	N/A	-0.000 (-.03)	0.008 (1.88)	.018 (1.92)	-.065 (-1.17)
Dummy	-0.678**[a] (-6.16)	-0.846**[a] (-7.85)	-.383*[b] (-1.79)	N/A	N/A	N/A	N/A	N/A
R^2	0.938	0.958	.175	.03	.925	.915	.647	.439

*Significant at 10% level
**Significant at 5% level

[a]Dummy for export subsidy through 1972.

[b]Dummy for demand shift in 1973.

For wheat, export volume and export prices are taken from International Wheat Council, International Wheat Statistics, various issues. Export price for hard red winter is for #2, 13% protein, fob Gulf. Export price for dark northern spring is the average of fob Gulf and Pacific prices for 14% protein. Wholesale prices for wheat are "prices to millers" for the same types of wheat and protein content, and were taken from Economic Research Service, USDA, Wheat Situation and Wheat Situation and Outlook, various issues. The wholesale price for hard red winter is the Kansas price, and the wholesale price for dark northern spring is the Minnesota price.

Export prices and volume and wholesale prices for corn and soybeans are from Economic Research Service, USDA, Agricultural Outlook, October 1986. Export prices are fob Gulf, and wholesale prices are Chicago prices for #2 yellow corn and #1 yellow soybeans.

All prices are deflated by the consumer price index taken from Agricultural Outlook.

Table 6. Partial Effects of Export Volume and Trend of U.S. Export - Wholesale Price Differential

Year	Export	t-Stat.	Time	t-Stat.				
			Wheat (hrw)					
62	0.024	0.771	0.0079	0.6918				
63	0.023	0.778	0.0058	0.5961				
64	0.022	0.7851	0.007	0.6657				
65	0.021	0.7921	0.0056	0.5882				
66	0.02	0.7989	0.0069	0.6601				
67	0.019	0.8051	0.0067	0.6518				
68	0.018	0.8103	0.0089	0.7088				
69	0.017	0.8139	0.0082	0.6986				
70	0.016	0.8149	0.007	0.6625				
71	0.0149	0.8122	0.008	0.6954				
72	0.0139	0.8042	0.0025	0.2557		Wheat (hrw)		
73	0.0129	0.7891	0.0028	0.2963				
74	0.0119	0.7648	0.0038	0.4153	0.0801**	5.088	0.0208**	3.0017
75	0.0109	0.7294	0.0026	0.275	0.0674**	4.6792	0.0058**	0.9632
76	0.0099	0.6817	0.0045	0.4918	0.0547**	4.1521	0.0298**	3.8598
77	0.0089	0.6216	0.0026	0.2776	0.0421**	3.4755	0.006	1.0057
78	0.0079	0.5511	0.0023	0.2358	0.0294**	2.6225	0.0016**	0.2718
79	0.0069	0.4732	0.0008	0.0696	0.0167	1.5862	-0.0176**	-2.9771
80	0.0059	0.3921	-0.0013	-0.0969	0.0041	0.4006	-0.0432**	-5.6039
81	0.0049	0.3116	-0.004	-0.234	-0.0086*	-0.8507	-0.077**	-6.702
82	0.0039	0.2349	-0.0003	-0.0213	-0.0213**	-2.0551	-0.0304**	-4.5808
83	0.0028	0.1639	0.0001	0.0099	-0.0339**	-3.1172	-0.0257**	-4.07
			Wheat (dns)					
62	0.055*	1.8015	0.0126	1.1274				
63	0.0518*	1.787	0.0058	0.6147				
64	0.0486*	1.7694	0.0099	0.9565				
65	0.0454*	1.7477	0.0055	0.5811				
66	0.0422	1.721	0.0095	0.9248				
67	0.039	1.6879	0.0089	0.8792				
68	0.0358	1.6467	0.0157	1.281				
69	0.0326	1.5954	0.0136	1.1818				
70	0.0294	1.5314	0.0097	0.9384				
71	0.0262	1.4517	0.0131	1.1551				
72	0.023	1.3529	-0.0047	-0.4936		Wheat (dns)		
73	0.0198	1.2315	-0.0036	-0.3849				
74	0.0166	1.0849	-0.0003	-0.0374	0.0434*	2.3449	-0.0146**	-1.7938
75	0.0134	0.9118	-0.0041	-0.4423	0.0342	2.0145	-0.0256**	-3.6339
76	0.0102	0.7139	0.0019	0.2143	0.0249	1.6033	-0.008**	-0.8848
77	0.007	0.4964	-0.0041	-0.4356	0.0156	1.0949	-0.0254**	-3.5995
78	0.0038	0.268	-0.0052	-0.5454	0.0063	0.4791	-0.0287**	-4.1713
79	0.0006	0.039	-0.01	-0.9411	-0.003	-0.2379	-0.0428**	-6.1301
80	-0.0026	-0.1805	-0.0165	-1.2772	-0.0122	-1.0217	-0.0615**	-6.7732
81	-0.0058	-0.3828	-0.0251	-1.5085	-0.0215*	-1.8094	-0.0862**	-6.3774
82	-0.0091	-0.5634	-0.0133	-1.132	-0.0308**	-2.5288	-0.0521**	-6.6736
83	-0.0123	-0.721	-0.0121	-1.0685	-0.0401**	-3.1279	-0.0487**	-6.5413