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DOMESTIC FARM POLICY AND THE GAINS FROM TRADE

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California Agricultural Experiment Station
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Domestic Farm Policy and the Gains from Trade

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Domestic Farm Policy and the Gains from Trade

In recent years many of the grain exporting countries, such as the United States, have experienced a phenomenal expansion in their volume of export shipments. However, this expansion has not been due only to competitive supply and demand forces. Domestic government policies such as price supports and input subsidies have also played a significant role. As a result, although the volume of exports is large, one has to ask the fundamental question: Are there any economic gains generated from these exports because of the influence of trade barriers and domestic farm programs? It is interesting that the many papers written (on the 1985 U. S. Farm Bill, for example) seem to side step the important gains from trade issue by neglecting the important theoretical literature on the gains from trade.

This question of economic gains from trade can be addressed in the context of gains from trade theory. This paper shows that, even though the volume of trade is large in physical terms, the economic gains from these shipments can be small or nonexistent. This is because of the influence of international trade barriers and domestic farm programs. In this paper, the critical no gains from trade point is derived. This results because farm programs, such as production subsidies, in the presence of international trade barriers can completely eliminate any trade gains. This can occur even though the volume of trade may be substantial because the exporter subsidies are transferred to importers as well as to domestic producers while the general public bears the cost. To assess the plausibility of these results, numerical calculations based on the international wheat market are made. Also, the sugar market is considered where, unlike for wheat, the United States is a major importer.

Figure 1. Tariff, quotas, subsidies, and no gains from trade.

The Model

A simplified model of the impact of domestic farm policy on the gains from trade is shown in figure 1. For a given commodity, ES_{FT} is the excess supply curve and ED_{FT} is the excess demand curve. It follows from standard trade theory (Letiche, Chambers, and Schmitz) that the benefit from trade at quantity Q_{FT} and price P_{FT} is area ABC with area ABP_{FT} representing importers' gains while the exporter gains $P_{FT}BC$.¹

Free trade is, however, rarely observed. Distortions, such as tariffs and quotas, are usually the rule rather than the exception. In addition, exporters distort domestic production by input and output subsidies and the like. As examples, in the world wheat market, importing countries (such as Japan) or regions [such as the European Economic Community (EEC)] have placed sizable tariffs on imported wheat. This shifts the excess demand curve to the left for wheat exporters such as the United States. Exporting countries (e.g., Canada and the United States) have typically responded to the numerous trade barriers in various ways (e.g., subsidizing production in an attempt to preserve export levels by shifting the excess supply curve to the right). On the other hand, in the sugar market the United States is a major importer where imports are restricted by quotas. This raises U. S. prices and lowers world prices.

The model in figure 1 is capable of showing the effects on the gains from trade of both trade barriers and production subsidies. Consider first an import good, such as sugar, for which, with free trade, imports are Q_{FT} and price is P_{FT} . The U. S. sugar quotas restrict imports to Q^q , and domestic prices rise to P^q . Prior to the quota, the gains from trade for the United

States measured in the sugar market were ABP_{FT} ; the quota reduced these gains by $P^Q_aBP_{FT}$ leaving area AaP^Q as the net gains after the quota. For exporters, the gains from trade are reduced by $P_{FT}BFP_1$ leaving only area P_1FC as the exporter's gain from trade. The net loss for both exporters and importers taken together is aBF . There have been empirical estimates of area $P^Q_aBP_{FT}$ (Schmitz, Allen, and Leu) for the United States. The loss in the U. S. portion of the world gains from trade in sugar easily exceeds \$1.5 billion annually. The estimates, however, show that there are gains from trade to both the exporter and the importers even with the quota (i.e., areas AaP^Q and CFP_1 are positive).

Now consider an export good such as U. S. wheat. In this case, ED_{FT} is the excess demand curve for a U. S. export good while ES_{FT} is the excess supply curve. Exports by the United States are Q_{FT} at prices P_{FT} if free trade prevails. Unlike the above case, a point can be reached at which, even though the volume of trade is positive, the economic gains from this trade are nonexistent. The free trade equilibrium originally is given by price P_{FT} and quantity Q_{FT} . The exporter's trade gain is area $P_{FT}BC$, and the importers' gain is ABP_{FT} . If the importers place a tariff on imports such that the excess demand curve shifts to ED' ,² the exporting country, if it wishes to keep the quantity traded at Q_{FT} , must institute an equivalent subsidy that shifts the excess supply curve outward to ES .

The policy response to the tariffs is increased production through subsidies. To be at the original level of free trade exports after the tariff and subsidy are in place, the new equilibrium price is P_1 ; the quantity

exported still remains at the free trade quantity Q_{FT} . The exporter's surplus is now area P_1ED , which is equivalent to area $P_{FT}BC$ (the free trade exporter surplus) because the two curves have shifted by the same amount. At price P_1 , the total gain to the exporting country is then area P_1ED minus the cost of the subsidy $P_{FT}BEP_1$. Area P_1ED consists of two parts: area P_1FC , which is part of the old surplus, and area $CFED$, which is the new export surplus due to the supply shift. The subsidy required to maintain production at Q_{FT} is $P_{FT}BEP_1$ consisting of the two areas $P_{FT}BFP_1$ and BFE . Clearly area $CFED$ is equal to area $P_{FT}BFP_1$ since area $P_{FT}BC$ is equal to area P_1ED . When price P_1 is midway between price P_{FT} and intercept term C , areas P_1FC and BFE are equivalent, so the new exporter's surplus P_1ED is equal to the total subsidy $P_{FT}BEP_1$. Therefore, there is no longer a gain from trade; the subsidy component is exactly equal to the producer's surplus. We have in essence established the point at which, although the volume of trade is the same as under free trade, the gains from trade are zero. The gains from trade have been eroded because of distortions put in place by both importers and exporters.

To establish the result more rigorously, consider a model in which excess demand and supply are originally given by

$$(1) \quad ED = a - bP$$

$$(2) \quad ES = -u + vP$$

where a, b, u , and $v > 0$. Then free-trade price and quantity are

$$(3) \quad P_{FT} = \frac{(a + u)}{(b + v)}$$

$$(4) \quad Q_{FT} = \frac{(av - bu)}{(b + v)}.$$

We now wish to consider the effect of, say, an import tax imposed by the importing country on the world price. Assume that the initial world price is given at P_{FT} . By introducing a parameter, k , that represents the percent of world price that is an import tax, we can derive the new excess demand function as

$$(5) \quad ED_1 = a - b(P + kP_{FT})$$

where $k > 0$. When k rises, exports of the domestic country are less attractive to foreign importers. A similar parameter, w , which represents the percent of world price that is a subsidy on production, can be introduced to give the new exporter's excess supply function,

$$(6) \quad ES_1 = -u + v(P + wP_{FT})$$

where $w > 0$.

We are interested in determining the level of k that leads to a situation of no gains from trade to the exporter if it responds with an equivalent w so that the export level is maintained at Q_{FT} . The new equilibrium condition is

$$(7) \quad ED_1 = ES_1 = Q_{FT},$$

and the new equilibrium world price can be solved as

$$(8) \quad P_1 = \frac{(a - Q_{FT} - bkP_{FT})}{b}.$$

Substituting (4) into (8) gives

$$(9) \quad P_1 = \frac{[ab + bu - bk(b + v)P_{FT}]}{b(b + v)}.$$

As mentioned above, there will be no gains from trade if P_1 is in the middle of P_{FT} and the intercept term of the excess supply curve, u/v ; that is,

$$(10) \quad P_1 = \frac{(P_{FT} + u/v)}{2}.$$

Substituting (9) into (10) obtains

$$(11) \quad k = w = \frac{Q_{FT}}{2vP_{FT}},$$

or

$$(12) \quad k = w = \frac{(av - bu)}{2v(a + u)}.$$

Interestingly, in this case the importers do not suffer any loss in gains from trade as a result of their protectionist policy (note that ABP_{FT} in figure 1 equals $A'EP_1$). This result emerges because, in response to trade barriers, the United States subsidizes exports, thus lowering the export price of the good below what it would have been under free trade.

Sensitivity Analysis

In the previous section, we have shown that the tariff and the equivalent subsidy required for no gains from trade (given that the quantity traded is the same as it would be under free trade) depend on the coefficients of the excess

demand and excess supply curves. Note also that the magnitude of the shifts in these two curves, which result from the imposition of tariff and subsidy, depends on demand and supply elasticities and free trade quantities. In table 1, examples are constructed to examine this dependence. By varying the slope of excess demand or supply, the different shifts required to reach the point of no gains from trade are observed. A shift in the curves, expressed as k , is measured by the percent reduction of the free trade price at the free trade quantity.

In the first five examples, the slope of the supply curve is constant while the slope of the demand curve is varied. When b increases, the excess demand curve flattens such that the equilibrium free trade price P_{FT} and quantity Q_{FT} decrease. As a result, the shift of the curves required for no gains from trade is smaller while the demand and supply elasticities are larger.

These relations can be demonstrated by differentiating (3), (4), and (12) with respect to b ,

$$(13) \quad \frac{dP_{FT}}{db} = - \frac{(a + u)}{(b + v)^2} < 0$$

$$(14) \quad \frac{dQ_{FT}}{db} = - \frac{v(a + u)}{(b + v)^2} < 0$$

$$(15) \quad \frac{dk}{db} = - \frac{u}{2v(a + u)} < 0.$$

Note that the demand and supply elasticities are:

TABLE 1
Gains from Trade and Model Parameters

Example ^a number	Parameter		Price P_{FT}	Imports Q_{FT}	Elasticity of		Shift parameter (k)
	b	v			Demand	Supply	
1	0.2	0.5	236	93	0.51	1.27	39
2	0.7	0.5	138	43	2.25	1.60	32
3	1.0	0.5	110	30	3.67	1.83	27
4	1.5	0.5	83	16	7.78	2.59	20
5	2.0	0.5	66	8	16.50	4.13	12
6	0.5	0.2	236	22	5.36	2.14	24
7	0.5	0.7	138	71	0.97	1.36	37
8	0.5	1.0	110	85	0.65	1.29	39
9	0.5	1.5	83	99	0.43	1.26	40
10	0.5	2.0	66	107	0.31	1.23	41

^aExample equations used are: $ED = 140 - bP$ and $ES = -25 + vP$, where ED is excess demand and ES is excess supply.

$$(16) \quad \eta^D = - \frac{d(ED)}{dP} \frac{P_{FT}}{Q_{FT}} = \frac{b(a + u)}{(av - bu)}$$

$$(17) \quad \epsilon^S = \frac{d(ES)}{dp} \frac{P_{FT}}{Q_{FT}} = \frac{v(a + u)}{(av - bu)}$$

respectively. Differentiating (16) and (17) with respect to b obtains

$$(18) \quad \frac{d\eta^D}{db} = \frac{av(a + u)}{(av - bu)^2} > 0$$

$$(19) \quad \frac{d\epsilon^S}{db} = \frac{uv(a + u)}{(av - bu)^2} > 0.$$

In the last five examples, the slope of the demand curve is held constant and the slope of the supply curve is varied. The bigger the value of v , the flatter the excess supply curve which results in lower P_{FT} and higher Q_{FT} . Consequently, the shift in the curves becomes larger; and the demand and supply elasticities are smaller. Similarly, differentiating (3), (4), (12), (16), and (17) with respect to v obtains

$$(20) \quad \frac{dP_{FT}}{dv} = - \frac{(a + u)}{(b + v)^2} < 0$$

$$(21) \quad \frac{dQ_{FT}}{dv} = \frac{b(a + u)}{(b + v)^2} > 0$$

$$(22) \quad \frac{dk}{dv} = \frac{bu}{2v^2(a + u)} > 0$$

$$(23) \quad \frac{d\eta^D}{dv} = - \frac{ab(a+u)}{(av-bu)^2} < 0$$

$$(24) \quad \frac{de^S}{dv} = - \frac{bu(a+u)}{(av-bu)^2} < 0.$$

By changing the slopes, the overall shift in the curves required to create the position of no gains from trade also can be associated with a parallel change of quantity traded at that equilibrium point and the reverse changes in the demand and supply elasticities. To determine their relative relationships, first differentiate (11) with respect to Q_{FT} ,

$$(25) \quad \begin{aligned} \frac{dk}{dQ_{FT}} &= \frac{\partial Q_{FT}/\partial Q_{FT}}{2vP_{FT}} + \frac{Q_{FT}}{2v(\partial P_{FT}/\partial Q_{FT})} \\ &= \frac{(b+v)^2 + (av-bu)^2}{2v(a+u)(b+v)} > 0. \end{aligned}$$

Second, rewrite (11),

$$(26) \quad k = \frac{b}{2v\eta^D},$$

and

$$(27) \quad k = \frac{1}{2} \epsilon^S.$$

Differentiating (26) and (27) with respect to η^D and ϵ^S obtains

$$(28) \quad \frac{dk}{d\eta^D} = - \frac{b}{2v(\eta^D)^2} < 0$$

$$(29) \quad \frac{dk}{d\epsilon^S} = -\frac{1}{2} (\epsilon^S)^2 < 0.$$

These relations with k hold if we fix the slopes of both curves and vary the vertical intercept terms. Intuitively, the gains from trade are usually less at low quantities of trade compared to the gains from trading large quantities of goods. Therefore, when dealing with a small quantity of goods, a correspondingly small subsidy offsets the gains from trading these goods. As shown later, these shifts required to reach the point of no gains from trade seem quite plausible when the corresponding quantities and price elasticities are taken into account.

Input Subsidies, Price Supports, and Quantity Restrictions

In the above analysis excess supply shifts outward only because input subsidies are considered as the major farm policy instrument. However, in major grain exporting countries such as the United States, input subsidies are used along with price supports and acreage set-asides. The effect of these policy instruments is shown in figure 2. Suppose the excess demand curve, due to trade barriers, shifts from ED_{FT} to ED' and subsidies shift the excess supply curve from ES_{FT} to ES' so that the new equilibrium point E corresponds to a position of no gains from trade, i.e., $P_1 = 1/2(P_{FT} + C)$. If, instead of ES' , the subsidies cause only the shift of ES_{FT} to ES'' , the result is a price P_0 that is below the free trade price P_{FT} and a level of trade Q_0 that is below Q_{FT} . Clearly, positive gains from trade occur at E' because $P_0 > 1/2(h + C)$. However, if one now incorporates price supports and set-aside programs along with input subsidies, the picture changes dramatically. For example, a price support at P_{FT} coupled with a set-aside program

Figure 2. Input subsidies, price supports, and the gains from trade.

that reduces output from Q_s to Q_{FT} in addition to the input subsidy yields the same solution, i.e., no gains from trade, as did the case when the input subsidy shifts ES_{FT} to ES' . The only difference is that the total government outlay is area $P_{FT}BEP_1$ of which only the crosshatched area $P_{FT}Bab$ is made up of the input subsidy.

Interestingly, once one includes price supports and input subsidies, the shift in the excess supply curve can be much smaller than indicated previously before the point of no gains from trade is reached. The existence of price supports actually strengthens the hypothesis that the volume of trade can be large, but the economic gains from trade can be small or nonexistent.

An Example from the Wheat Market

Sharples and Paarlberg recently estimated the excess demand and supply curves for wheat as³

$$(30) \quad ES_w = 57.4 + .143P$$

$$(31) \quad ED_w = 142.8 - .284P.$$

These results are consistent with many empirical studies (see Schmitz et al.). As the reader will note, excess supply is positive even when price is zero which is somewhat implausible. Thus, an alternative method of estimating the horizontal intercept is used. Following Lindner and Jarrett, we compute the intercept over a range as a percentage of the equilibrium price (see figure 3).

The equilibrium price is \$200 per metric ton, and the equilibrium quantity is 86 million metric tons. The following excess supply equations are obtained by calculating the intercept at 70 percent and the equilibrium price at 30 percent, respectively.

Figure 3. Trade losses in the wheat market.

$$(32) \quad ES_w = -200.67 + 1.43P$$

$$(33) \quad ES_w = -36.857 + 0.614P.$$

The level of subsidy or tariff for the point of no trade gains is easily determined by modifying (31), (32), and (33) to include the distortions

$$(34) \quad ED = 142.8 - 0.284 (P + kP_{FT})$$

$$(35) \quad ES = -200.67 + 1.43 (P + wP_{FT})$$

$$(36) \quad ES = -36.857 + 0.614 (P + wP_{FT}).$$

Using (11), the k and the w required for no trade gains are 15 percent using excess supply equation (35) and 35 percent when using excess supply equation (36).

The results demonstrate that distortions shifting the free trade curves in the range of 15 to 35 percent can create a situation of no trade gains for the exporter. Any shift under 15 percent results in a trade gain; above 35 percent, it results in a trade loss. However, in view of the theoretical results, the shift in the excess supply curve can be much less than either the 15 percent or 35 percent even if the excess demand curve shifts by one of these percentages before there are no gains from trade.

Empirical studies exist on the magnitude of tariff and nontariff barriers on wheat along with subsidy levels in wheat production. The results are supportive of the hypothesis that, even though the volume of grain exports is large, the trade gains may be small. As examples, Carter and Schmitz find that the EEC variable levy in wheat was about 57 percent of world price for

1966-1973 and 1976-77. Sampson and Snape put the EEC variable levy on wheat in 1977 at 125 percent of world price; therefore, the quantitative spread between ED_{FT} and ED' in figure 2 is larger than the needed maximum of 35 percent for a no gains from trade solution. Doering, Schmitz, and Miranowski calculated the amount of price support and input subsidy on U. S. farm exports as approximately \$2.00 per bushel or 56 percent of the export price (table 2).⁴ This gives some idea of the magnitude of the spread between ES_{FT} and ES' in figure 2--a spread greater than the maximum 35 percent needed for no trade gains. As emphasized above, the shift can be much less than 35 percent for no gains from trade to occur. Also, as shown theoretically, although the gains for exporters may be greatly reduced from distortions, the gains to importers may be unaffected.

The numbers in table 2 are important with respect to the cost and value of U. S. wheat exports. The price received for exports covers only 65 percent of the expenses of high-cost producers. The three-year average price for wheat exceeds private costs, but it does not cover full costs. In essence, the importers obtained a subsidy of more than \$1.50 per bushel paid by exporters. A similar calculation by Doering, Schmitz, and Miranowski (p. 125) for corn showed that the export subsidy was roughly \$1.00 per bushel. As with wheat, part of this subsidy included price supports in addition to input subsidies. Also, recall the important earlier result that the gains from trade for importers were unaffected by distortions.

Conclusion

In this paper we have modeled trade and domestic policies together to show that, even though there may be a substantial volume of trade in a particular

TABLE 2

Average Estimated Total Costs of Production and Farm Level
Prices of Wheat, Selected Years

	Wheat (dollars per bushel)
Private costs, 1978-1980 (land at acquisition)	3.94
Input subsidies: Transportation	0.03
Research	0.006
Social costs: Erosion	0.14
Tax advantage: Profitable period	0.30-0.50
Unprofitable period	0.07-0.12
Program costs: Surplus purchases	0.61-1.35
Managing reserves	0.06
<u>Total costs:</u>	
Assuming profitable period and managing reserves	4.48-4.68
Assuming unprofitable period and surplus purchases	4.80-5.59
Assuming high-cost region ^a producing unprofitably with surplus purchases	5.17-5.96
Farm level prices: Average, 1978-1980	3.57

^aThe three-year (1978-1980) price for region(s) producing 14 percent of U. S. wheat.

Source: Doering, Otto, Andrew Schmitz, and John Miranowski. "Farm Costs and Exports." Increasing Understanding of Public Problems and Policies--1983. Oak Brook, Ill.: The Farm Foundation, 1983.

commodity, the economic gains from trade to a nation can be small or non-existent. Empirically, we considered two commodities, sugar and wheat. For sugar (a U. S. import good), import quotas greatly reduce the gains from trade to the United States; but the gains remaining, even with the quota, appear to be substantial. However, for an export good, such as wheat, the gains from trade to the United States could well be nonexistent even though the importers' gain from trade may be unaffected by U. S. production subsidies of various kinds.⁵

The results above are partly a result of a U. S. "passive" response to trade barriers--a response that includes the use of production subsidies of various types. Such a policy is passive in that it does not exert pressure on importers to remove their trade barriers which are the source of the problem. An "active" or "retaliatory" policy would include multiple pricing strategies or minimum purchase price agreements (Schmitz et al.). Unfortunately, the use of U. S. export taxes is unconstitutional.

The policy process does not take place in a vacuum; lobbying groups greatly influence policy direction.⁶ The outcome where the volume of trade can be large but the gains from trade are zero seems to be consistent with the activities of the major rent seekers in international trade. By way of a rent-seeking hypothesis, importers want stable prices and, as Carter and Schmitz have shown, one of their objectives is to use an optimal tariff strategy. Through their use of tariffs they can also transmit instability to exporters. Their protectionist policies effectively shift the excess demand curve in figure 1 to the left of the free trade curve. In response to these barriers, exporters effectively lower prices through a combination of production subsidies. This outcome would not be opposed by multinational grain firms that

profit from large trade volumes and price instability; these firms lobby for policies that lower export price in order to increase export volume. They would not lobby for a retaliatory government policy (e.g., export cooperation).

In our model, producers find it easier to maximize economic rents via government assistance than to promote exports via trade barrier reductions. The "gains from trade" that producers would receive through liberalized trade are substituted by government price supports. However, if producers did not have the government to lean on, they might obtain rents comparable to the subsidy case by dealing specifically with the trade barriers that cause excess demand to decline. In our model there is no incentive for producers to be aggressive in marketing, given the Santa Claus role of government in providing subsidies.

The above findings raise serious questions about the future direction of U. S. agriculture and trade policy. The 1985 Farm Bill adds strength to the no gains from trade argument since, by lowering loan rates, an export subsidy is given importers which increases their gains from trade. Surely policies can be implemented where U. S. exports are accompanied by significant gains for the U. S. economy.

Footnotes

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¹The gains from trade in a general equilibrium model are the sum of the areas under the excess supply and demand curves in the market for each good. See Just, Hueth and Schmitz for a general equilibrium market approach to the gains from trade question.

²The tariff is in a lump sum that causes a parallel shift in the excess demand curve. It can be shown easily that our model still applies where an ad valorem tariff is in place causing a pivotal shift in the excess demand curve.

³The ES_w consists of the United States, the Common Market (EC-10), Canada, Australia, and Argentina. The ED_w consists of Japan and all other importing countries.

⁴Glenn, Carter, and Tangri found similar results for Canada.

⁵An empirical question remains as to the economic gains from trade without distortions. To answer this question, there is a danger in using the standard arguments concerning the welfare effects of monopoly where the triangles are found to be small. In the model above, the supply and demand curves shift due to distortions, hence, their effects can be large. This is not the standard case, however, when analyzing the effects of monopoly power.

⁶This reference to rent seeking could be extended along the lines suggested by Rausser.

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