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When Are Export Subsidies Rational?

By Philip L. Paarlberg*

Abstract

The traditional model used to analyze trade issues suggests that an export subsidy on agricultural products is an irrational policy choice. However, export subsidies are common in world agricultural trade. By relaxing the assumptions of the traditional model, researchers can develop several frameworks for explaining the use of export subsidies.

Keywords

Export subsidy, trade policy

The use of export subsidies in world agricultural trade is widespread. Cochrane and Ryan (2) estimate that from 1955 to 1966, an average of 30 percent of agricultural exports received U.S. Government assistance.¹ Although U.S. subsidies were ultimately eliminated as support prices and market prices were harmonized, the recent low commodity prices, due in part to sluggish exports, have renewed the call for subsidies.

This article is designed to develop alternative conceptual frameworks for analyzing export subsidies. An export subsidy is any policy which allows a country to offer a price advantage in world markets. In the framework traditionally used to analyze trade issues, a neoclassical competitive model, export subsidies always reduce the welfare of the subsidizing country. Given the frequent use of export subsidies, either policymakers are acting irrationally or the assumptions of the competitive trade model are in error. In this article, I show that if several assumptions are changed, export subsidies can emerge as a rational policy instrument.

The Competitive Model

The first task is to analyze an export subsidy in the context of the standard competitive model, both

partial and general equilibrium, to provide a point of reference for later analysis. Many assumptions are made in this framework, but four assumptions are critical to analyzing an export subsidy. First, all goods are homogeneous and perfectly divisible. This assumption guarantees that the law of one price holds; for example, European Community wheat flour is indistinguishable from U.S. wheat flour. Second, the model is static and characterized by certainty. Third, all political interest groups have equal influence on the policymaker, thus, the policymaker's criterion function becomes the net social payoff. Fourth, there is no price manipulative behavior and all agents are price takers, thus, the subsidy is exogenous to the system and not the result of government behavior designed to manipulate the behavior of other governments.

Given these assumptions, the competitive free trade solution in the absence of the subsidy is determined by the intersection of the excess supply curve (ES_0) and the excess demand curve (ED_0) in the center panel of the figure. The free trade solution yields a price (P^F) and trade quantity (X_0). Introducing the export subsidy rotates the excess supply curve as perceived by the exporting country to ES_1 . An *ad valorem* export subsidy increases exports from X_0 to X_1 . It also introduces a wedge between the now higher domestic price, P , resulting from the smaller domestic supply in the exporting country, and the world price, P^W , facing the importing country. Because of these price changes, the income distribution in both countries shifts. The higher

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¹ Italicized numbers in parentheses refer to items in the References at the end of this article.

price in the exporting country results in a loss of consumers' surplus equal to area $P^F P a c$ in the left panel, which is transferred to producers who gain area $P^F P f e$. The cost of the subsidy to the government is equal to area $P^W P h k$ in the center panel. Area $P^W P^F i k$ is transferred to consumers overseas as the world price falls from P^F to P^W , and area $P^F P h i$ is retained by the home country. The area $P^F P z m$ is equal to area $b c d e$ and is a direct transfer from the exporting country's government to producers. Area $m z h$ in the center panel equals the sum of areas $a b c$ and $e d f$ in the left panel and is also a transfer from the government to producers. The net cost of the export subsidy to the exporting country is $m h i$ in the center panel, which is composed of the resource cost, area $e f g$ in the left panel, and the consumers' deadweight cost, area $v a c$. This cost represents the loss in welfare to the exporting country caused by the subsidy policy. Export revenue is given by $(P^F) \cdot (X_0)$ for free trade and by $(P^W) \cdot (X_1)$ in the distorted scenario, respectively. If the excess demand curve is elastic, export revenue

rises as a result of the subsidy. If the excess demand curve is inelastic, export revenue falls.

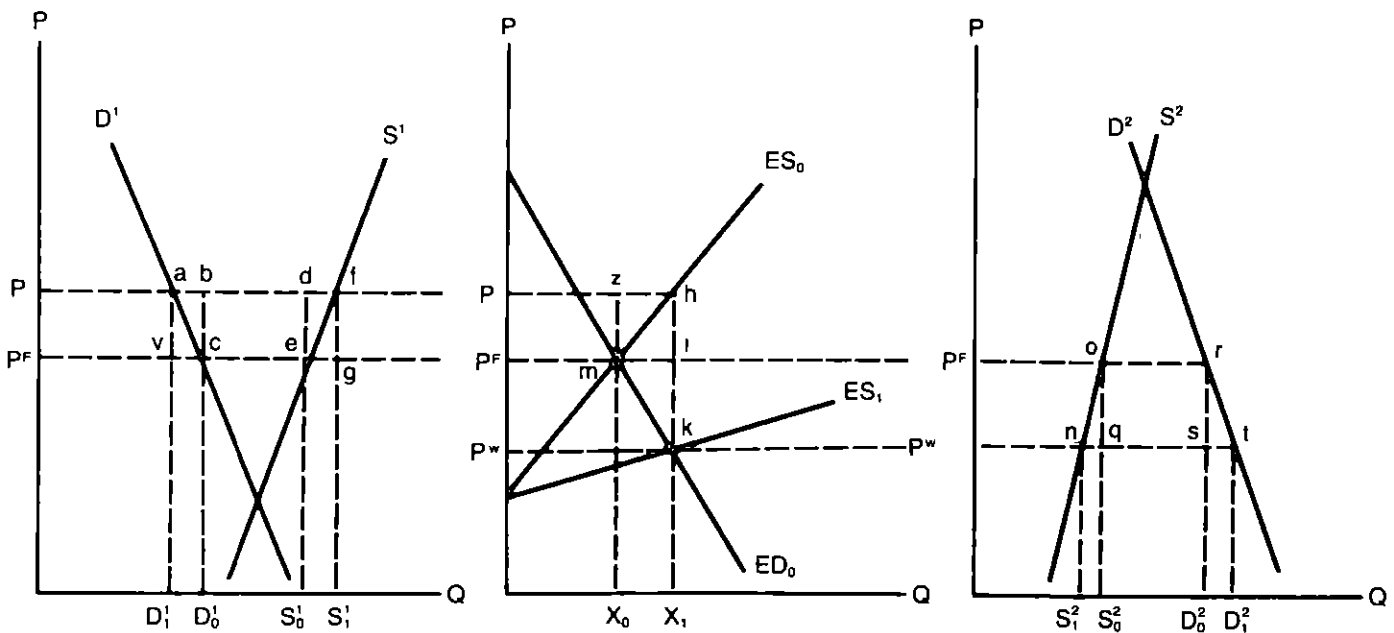
In the general equilibrium model with two goods, a similar result can be obtained. Let $U(C_1, C_2)$ be the social welfare function, which the country maximizes, subject to a budget constraint at world prices. Good 1 is assumed to be the export good upon which an *ad valorem* export subsidy, S , is levied, hence, $P_1 = P_1^W (1 + S)$, where P_1^W is the world market price of good 1 and where P_1 is the domestic price of good 1. Differentiating the social welfare function and the budget constraint at world prices and then substituting gives

$$\frac{dU}{U_1} = - \left[\frac{P_1^W}{P_2^W} \right] S dX + X d \left[\frac{P_1^W}{P_2^W} \right] + (dX) \left[d \left[\frac{P_1^W}{P_2^W} \right] \right] \quad (1)$$

where X = exports of good 1 by the country

The first right-hand side term of equation (1) is the trade effect which, because the subsidy expands

An Export Subsidy in a Neoclassical Model



exports, lowers welfare. The second term on the right side represents the terms of trade effect which, because the subsidy lowers the world price of good 1, lowers the welfare of the country. The sign of the third term is also negative as exports expand and as the relative price of good 1 in the world market falls. Thus, these effects cause a decline in national welfare when the subsidy is imposed.

The above competitive model represents the conventional wisdom. Export subsidies are irrational both for the small country, which cannot influence its terms of trade, and for the large country, which can affect its terms of trade. In fact, equation (1) suggests the opposite policy for a large country. By the imposition of an export tax ($S < 0$), welfare can be enhanced, if the terms of trade gain outweighs the trade effect plus the final term.²

The Case for Export Subsidies

Given that an export subsidy is an irrational device in the above model, two issues remain. Why are they used so frequently? How should the policy researcher analyze export subsidies? That suggests either that the previous model is an incorrect formulation of the behavior of countries in the world market or that policymakers are irrational. Relatively minor modifications of the model, however, can provide insights into why subsidies are used. The rest of this article illustrates how relaxing the four assumptions can suggest a subsidy as the rational response.

Unequal Weights for Producers and Others

The changes in income distribution shown in the figure result from a specific assumption about the behavior of policymakers, and they suggest a role for an export subsidy. The behavior of policymakers can be described by a criterion function of the form (7)

$$W = \gamma^P \int_0^P S(P) dP - \gamma^C \int_0^P D(P) dP - \gamma^T \alpha X \quad (2)$$

where γ^P , γ^C , γ^T are the marginal weights the policymaker places on the welfare accruing to producers,

² With an export tax, $dx < 0$ and the world price ratio rises. Thus, the first and third terms of equation (1) are negative, and the second term is positive.

consumers, and taxpayers, respectively, α is the export subsidy which is added to the world price, P^w , to obtain the domestic price, P , X is the volume of exports which equals imports and is a function of world price; and $S(P)$ and $D(P)$ are the domestic supply and demand functions. The constraint facing policymakers who maximize their welfare is that the market must clear, or $X - S + D = 0$. To determine the optimum level of α , form the Lagrangian (L), substitute the price linkage into equation (2), and differentiate with respect to the endogenous variables α , P^w , and λ .

$$\frac{\partial L}{\partial \alpha} = \gamma^P S(P^w + \alpha) - \gamma^C D(P^w + \alpha) - \gamma^T [X(P^w)] + \lambda \left[-\frac{\partial S}{\partial P} + \frac{\partial D}{\partial P} \right] = 0 \quad (3)$$

$$\frac{\partial L}{\partial P^w} = \gamma^P S(P^w + \alpha) - \gamma^C D(P^w + \alpha) - \gamma^T \alpha \frac{\partial X}{\partial P^w} + \lambda \left[\frac{\partial X}{\partial P^w} - \frac{\partial S}{\partial P} + \frac{\partial D}{\partial P} \right] = 0 \quad (4)$$

$$\frac{\partial L}{\partial \lambda} = X(P^w) - S(P^w + \alpha) + D(P^w + \alpha) = 0 \quad (5)$$

In the competitive model, the weights on producers and consumers are equal—that is, $\gamma^P = \gamma^C$, and the weight on taxpayers equals zero ($\gamma^T = 0$). From equations (3) and (4), α must equal zero and these first-order conditions will disappear. If the weights are all set equal to one another, including the weight on taxpayers, then from manipulating equations (3) and (4), the *ad valorem* policy (α/P^w) is given by

$$\alpha/P^w = \frac{1}{\epsilon^x} \quad (6)$$

where ϵ^x is the elasticity of excess demand, which is negative. For a small country, $\epsilon^x = -\infty$, hence, $\alpha = 0$. For a large country, $\epsilon^x < 0$, hence, in this instance, the optimal policy is an export tax, $\alpha < 0$.

Recall from the figure that producers' surplus increases as a result of the export subsidy. If the government weights the welfare of producers more than that of others (a relaxation of the third assumption), then an export subsidy can be appropriate.

Let $\gamma^c = \gamma^T = \gamma$ and let $\gamma^P = \theta\gamma$ where θ is a measure of the extra weight the government places on producers' welfare. Substituting these expressions into equations (3) and (4) and solving for the *ad valorem* intervention (α/P^w) gives

$$\alpha/P^w = \frac{1}{\epsilon^x} + \frac{S(1-\theta)}{P^w \left[-\frac{\partial S}{\partial P} + \frac{\partial D}{\partial P} \right]} \quad (7)$$

Because domestic demand is negatively sloped (well-behaved), the denominator of the second term on the right side is negative. The numerator is negative for values of $\theta > 1$, hence, the second term on the right side is positive. Therefore, there is a range of values for θ so that $\alpha > 0$, an export subsidy. The range of values depends on the elasticity of excess demand, ϵ^x , and on the level of production, S . The closer ϵ^x is to zero, the greater θ must be for an export subsidy to be rational. The larger production is, the smaller θ must be. An export subsidy can be the optimal policy only if $\theta > 1$.

Market Strategy

The model developed in the previous section can be expanded to include a second time period, thus relaxing the second assumption. Game theory can be incorporated to illustrate how an export subsidy can be used to exercise market power in confrontation with several countries, thus relaxing the fourth assumption.³ The following scenario is similar to limit-pricing models in the industrial organization literature (8) and to the dynamic game of the corn market presented by Karp (4). In those models, an export subsidy is used to limit future entry by other exporters or to drive out competition.

The model assumes there are two periods and the country—that is, country 1—can select a trade policy intervention (α_i) in each period, $i = 1, 2$. The policymaker is assumed to maximize welfare over both periods where the welfare of the second period is discounted by a factor, ρ , subject to the market clearing in both periods. The model of the previous section is expanded to include one importing country as before as well as a rival exporting country.

For simplicity, the importing country is assumed to behave competitively, although it need not, according to the excess demand function in period 1, $M_1 = M_1(P_1^w)$. The rival, country 2, is assumed to have a known reaction function to the policy intervention. In period 1, the rival is assumed to adjust exports (X_1^2) in response to the trade policy in period 1 only.

$$X_1^2 = X_1^2(\alpha_1); \partial X_1^2 / \partial \alpha_1 \leq 0 \quad (8)$$

The greater the subsidy by country 1 in period 1, the lower the level of exports by country 2. In the second period, country 2 adjusts the level of exports depending on the policy choice made by country 1 in both periods.

$$X_2^2 = X_2^2(\alpha_1, \alpha_2); \partial X_2^2 / \partial \alpha_1 \leq 0, \\ \partial X_2^2 / \partial \alpha_2 \leq 0 \quad (9)$$

Given these assumptions, the modified model presented earlier can be written as

$$\begin{aligned} \text{MAX } W = & \gamma_1^P \int_0^P S_1(P_1^w + \alpha_1) dP_1 \\ & - \gamma^c \int_0^P D_1(P_1^w + \alpha_1) dP_1 \\ & - \gamma_1^T \alpha_1 [M_1(P_1^w) - X_1^2(\alpha_1)] \\ & + \rho \left[\gamma_2^P \int_0^P S_2(P_2^w + \alpha_2) dP_2 \right. \\ & - \gamma_2^c \int_0^P D_2(P_2^w + \alpha_2) dP_2 \\ & \left. - \gamma_2^T \alpha_2 [M_2(P_2^w) - X_2^2(\alpha_1, \alpha_2)] \right] \quad (10) \end{aligned}$$

subject to

$$\begin{aligned} M_1(P_1^w) - X_1^2(\alpha_1) - S_1(P_1^w + \alpha_1) \\ + D_1(P_1^w + \alpha_1) = 0 \quad (11) \end{aligned}$$

³ Game theory is a body of literature which analyzes the behavior of agents in conflict situations.

$$M_2(P_2^w) - X_2^2(\alpha_1, \alpha_2) - S_2(P_2^w + \alpha_2) + D_2^w(P_2^w + \alpha_2) = 0 \quad (12)$$

Equations (10) through (12) can be reformulated as a LaGrangean expression as in the first model, and the first-order conditions can be determined. Given these conditions, the optimal values of α_1 , α_2 , P_1^w , P_2^w , λ_1 , and λ_2 can be determined.

This model differs from the previous model in two ways. The first is the presence of the time discount parameter, ρ . As the value of ρ rises, country 1 is more willing to engage in subsidies in the first period to reduce the role played by its rival. Another major difference is the presence of the reaction functions which characterize country 2's behavior. The greater the reduction in exports by the rival due to a subsidy, the more successful the subsidy policy is. If the response of the rival is zero, then using export subsidies to reduce future entry or to drive out competition will not be effective.

Relaxation of Assumption of Homogeneous Good

The export subsidy analyzed in the figure is based on the assumption of a homogeneous good and the law of one price. Relaxing this assumption creates two cases in which a subsidy could be a rational policy.

If the good is distinguished in terms of quality, or services provided—that is, differentiated—a shortrun subsidy could be used to convince importers of the gains from buying from a particular source. This situation can be modeled either as a competitive differentiated product as Grennes, Johnson, and Thursby did (3) or as a noncompetitive differentiated product model (9). However, for interchangeable commodities such as agricultural products, the payoff from a differentiated product model could be small as the substitutability is high.

The second case is that of a targeted subsidy. In the model presented by the figure, unless the subsidy causes an expansion in world demand via the income

effect of the subsidy, gains in trade to one market are offset by losses to others. For example, if the United States subsidizes wheat sales to Brazil and increases exports to that market, other competitors replace an equal amount of sales in markets vacated by the United States—if wheat is homogeneous. If there is no shift in world demand through an income effect from the subsidy to Brazil, the world price is unchanged. If there is a strong income effect, demand is greater and the price rises. If the wheats of the different exporters are not perfect substitutes, sales by other competitors cannot fully replace U.S. sales lost, and the United States gains from the subsidy, even without an income effect.

Other Objectives

Thus far, the underlying behavioral assumption has been that of welfare maximization, either weighted or unweighted. However, McCalla (5, 6), Taplin (10), and Alaouze, Watson, and Sturgess (1) have suggested alternative forms of behavior. These authors suggest export sales or sales revenue maximization as a criterion. If pricing occurs in the elastic range, export earnings can then be increased by offering a subsidy to reduce prices and expand exports (see figure). Export earnings will rise until exports reach the point of unity on a linear excess demand schedule.

An Empirical Illustration

To illustrate the issues outlined in the conceptual frameworks, I employ a simple model of the world coarse grains market. I analyze scenarios with a relatively elastic excess demand function and those with a less elastic one. The scenarios determine the minimum value for the extra weight on producer welfare for the United States to select a subsidy. The model in which export subsidies are used to exercise world market power is not solved because to do so would require additional data on U.S. income distribution, discount rates, and the reactions of rival exporters. Karp (4) also presents a solution to this type of model, which shows the United States setting an export subsidy in the initial periods and then adopting a tax.

Basic Model

The empirical model used is based upon one by Sharples and uses 1977-81 as its base period⁴. Supply-utilization-price data and elasticity assumptions are all the data needed (see table). The United States produces 212 million metric tons of coarse grains, consumes 150 million tons domestically, and exports 62 million tons. The price is arbitrarily set to equal 100 to simplify the computations. All schedules are more elastic in case 1, particularly the excess demand schedule confronting the United States.

Supply-utilization price and elasticity assumptions for illustrative coarse grains model

Item	Base solution ¹	Elasticities ²	
		Case 1	Case 2
United States			
Supply	212	0.4	0.2
Domestic use	150	-5	-2
Exports	62	-5.0	-1.5
Price ³			
Domestic	100	n a	n a
World	100	n a	n a

n a = Not applicable

¹ Base solution for 1977-81 from analysis by Sharples. As there was no trade policy intervention by the United States, domestic and world prices are equal.

² Longrun elasticities, assuming production response in the rest of the world.

³ Price is assumed to equal 100 to facilitate computations and to allow easy adjustment to any true value.

Source: Jerry Sharples, ERS, Purdue University.

Uneven Weights

I argued earlier that, if the weight of producer welfare in the government criterion function exceeds that of others by some value, θ , there exists a value, θ_0 , above which an export subsidy is the appropriate choice. Given the values shown in the table, these critical values for θ_0 can be solved by use of equation (7). Setting α equal to zero determines the point at which the tax shifts to subsidy, θ_0 . For case 1, if the weight the U.S. policymaker places on producer welfare is 15 percent greater than that of

others, an export subsidy is appropriate. For case 2, the critical value of θ is about 23 percent. Thus, as the excess demand function becomes less elastic, θ_0 rises.

The opposite direction is also valid. By specifying the value of θ , one can determine the appropriate export tax or subsidy. One can calculate values for the weights in the wheat market using a revealed preference methodology discussed by Paarlberg (7) in which actual policy choices reveal the implied marginal weights for different groups. For the United States, these results suggest producer welfare is valued by 5-10 percent more than other groups, except for livestock feeders. If the patterns of weights in the Government's criterion function for coarse grains are similar, an export subsidy is not so irrational as the neoclassical model suggests.

Conclusions

My purpose here is to argue that an export subsidy policy which appears irrational in the context of traditional trade models may not be so if the assumptions are modified. Relaxing the assumption of homogeneity suggests that an export subsidy could provide benefits by exploiting the advantages of a differentiated product and income effect from the subsidy. Allowing a more flexible specification of the government's criterion function shows that an export subsidy can result from a higher marginal weight on the welfare of producers. An empirical example for the U.S. coarse grains market suggests that if producer welfare receives 15-25 percent more weight than that of others, an export subsidy may be the optimal policy choice. Given the concentrated power of producers, there is every reason to expect producers to have more influence than others. The question is one of degree of influence and of the price sensitivity of the system. Another model illustrates the consequences of recognizing strategic price manipulative behavior and the role of dynamics. The ability of a country to force reductions in exports by competitors or to discourage future entry using export subsidies is largely conditional upon the rivals' responses. Proponents of using export subsidies in this manner suggest the signs of the behavioral parameters of rivals are negative and of sizable magnitude. Critics of using export subsidies to exercise influence over other nations assume these parameters are slightly negative, or zero.

⁴ The simple model is provided by Jerry Sharples, an ERS employee at Purdue University.

References

- (1) Alaouze, C M., A S Watson, and N H Sturgess "Oligopoly Pricing in the World Wheat Market," *American Journal of Agricultural Economics*, Vol , 60, 1978, pp 173-85
- (2) Cochrane, W W , and M E Ryan *American Farm Policy 1948-1973* Minneapolis Univ of Minnesota Press, 1976
- (3) Grennes, T , P. R Johnson, and M. Thursby *The Economics of World Grain Trade* New York Praeger Publishers, 1977
- (4) Karp, L. S *Dynamic Games in International Trade* Ph D dissertation, Univ of California-Davis, 1982
- (5) McCalla, A F "A Duopoly Model of World Wheat Pricing," *Journal of Farm Economics*, Vol 48, 1966, pp 711-27
- (6) _____ "Wheat and the Price Mechanism Or Duopoly Revisited and Abandoned," *Seminar on Wheat Papers and Summary of Discussions of the 1969-1970 Seminar Series Occasional Series No. 2*, Univ of Manitoba, Dept of Agricultural Economics, Oct., 1970.
- (7) Paarlberg, P L *Endogenous Policy Formation in the Imperfect World Wheat Market* Ph D dissertation, Purdue Univ , 1983
- (8) Scherer, F M *Industrial Market Structure and Economic Performance*. Chicago Rand McNally College Publishing Co , 1980
- (9) Shubik, M , with R Levitan *Market Structure and Behavior* Cambridge, Mass Harvard Univ Press, 1980
- (10) Taplin, J H *Demand in the World Wheat Market and the Export Policies of the United States, Canada and Australia* Ph D dissertation, Cornell Univ , 1969