Are More Exports Always Better?: Comparing Cash and In-Kind Export Subsidies

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Before the introduction of the Export Enhancement Program (EEP) two types of export subsidies had been used by the United States: a direct cash subsidy for wheat exports and an export payment-in-kind (PIK) for feed grains, cotton, rice, and non-fat dry milk. Under the original export PIK program, exporters showing proof of export sales were given certificates redeemable for Commodity Credit Corporation (CCC) commodities to be exported (Cochrane and Ryan). The EEP reintroduced in-kind export subsidies in 1985.

This paper compares the relative effectiveness of cash and PIK export subsidies in increasing agricultural exports, real prices, and real incomes. Because agricultural policy ultimately must be judged by how it affects agriculture's relative position in the economy, the framework is general equilibrium. The model considers the interplay between farmers, international middlemen, nonfarm producers, domestic consumers, and foreign consumers. The analysis shows that the ability to enhance real farm income is sensitive both to the form (cash subsidies versus PIK subsidies) and point of policy intervention (at the farm or export level). In particular, the results demonstrate that PIK subsidies of the type granted under the EEP can decrease real farm income. From production agriculture's perspective, an export PIK program (even though it raises total agricultural exports) is not a sure path to improving agriculture's position in the general economy. Sometimes less exports are better.

We first introduce the model. The second section reexamines, solely for comparative purposes, the consequences of introducing cash subsidies to commercial exporters. The third section examines in-kind export subsidies

given to farmers, and the fourth considers in-kind subsidies to commercial traders. The fifth section reexamines these results when the real target price of the agricultural good is fixed. Next tied PIK export subsidies are considered. Finally, the effects of contemporaneous existence of price-support operations on the results are discussed.

The Model

Technology and Preferences

There are two countries. In the home country four goods are produced: a nontraded agricultural intermediate good, a nontraded nonagricultural intermediate good, a traded agricultural good, and a traded nonagricultural good. Intermediate-goods production is governed by the input-nonjoint producible output set:

$$(1) \qquad Y(L,K_1,K_2) = \left\{(z_1,z_2):\ z_i \in Y_i(L_i,K_i)(i = 1,2);\ \sum_{i=1}^{2} L_i \leq L\right\}$$

where $z_i \in \mathbb{R}_+$, $L_i \in \mathbb{R}_+$, $K_i \in \mathbb{R}_+$ $(i = 1,2)$ and $Y_i(K_i, L_i)$ is a scalar-output producible output set satisfying usual properties (Chambers). The index 1 refers to the intermediate agricultural good. L_i and K_i are a mobile factor devoted to the production of good i and the total endowment of a nontraded i^{th} sector- specific factor, respectively. The total endowment of the mobile factor of production, L, is in fixed supply and not traded internationally. The production technology is thus of the Ricardo-Viner type familiar from trade theory (Jones; Dixit and Norman). Moreover, assume that:

$$(2) \qquad Y_i(tK_i, tL_i) = tY_i(K_i,L_i) \quad t > 0.$$

Production of each intermediate output satisfies constant returns to scale.

A dual representation of the technology is the restricted profit function:

$$(3) \qquad \pi_i(p_i, w; K_i) = \underset{L_i, z_i}{\text{Max}} \{p_i z_i - wL_i : y_i \in Y_i(K_i, L_i)\}$$

$$= K_i \pi_i(p_i, w)$$

where w is the price of the mobile factor of production and p_i (i = 1,2) is the price of the i^{th} intermediate good. The linearity of (3) in K_i follows from constant returns to scale. Expression (3) is the quasi-rent accruing to the i^{th} sector-specific factor and $\pi_i(p_i, w)$ (i = 1,2) is the rental rate of the i^{th} sector-specific factor of production. Each $\pi_i(p_i, w)$ is convex and positively linearly homogeneous in its arguments, nondecreasing in p_i, and nonincreasing in w. Moreover, assuming that a unique solution to (3) exists implies by Hotelling's Lemma that (3) is differentiable and that:

$$(4) \qquad L_i(p_i, w, K_i) = -K_i \frac{\partial \pi_i(p_i, w)}{\partial w} \qquad i = 1,2 \ ,$$

where $L_i(p_i, w, K_i)$ is the profit-maximizing derived demand for the mobile factor in the i^{th} intermediate industry.

Because $K_i \pi_i(p_i, w)$ is the quasi-rent accruing to the owners of the i^{th} sector-specific input, it is interpreted as the income accruing to the i^{th} sector. Thus, $K_1 \pi_1(p_1, w)$ is farm or agricultural income. (For example, K_1 can be interpreted as agricultural land.) Using the Ricardo-Viner technology permits identification of how different sectors' real incomes are affected by export policies. Thus the focus is on the real-income distributional effects of these programs. No welfare analysis based on a community indifference curve is presented for two reasons: 1) because all the policies considered

below amount to the domestic country giving away real income [see equations (9)], the competitive assumptions of the model insure that the country must fall to a lower indifference curve as a result of the policy; 2) the aggregation conditions required for the existence of such a community indifference curve [individual expenditure functions must be of the GL form (Muellbauer)] are so restrictive that little realism is gained by their imposition.

Domestic demand for the i^{th} intermediate good is given by the well-behaved demand functions $c_i(p_1, p_2, E)$ $(i = 1,2)$ where E is expenditure on goods 1 and 2. Each c_i is homogenous of degree zero in its arguments and is integrable. Because the first intermediate good is an agricultural good, Engel's law suggests that its income elasticity is small. Coupling this low elasticity with the relatively small percentage of income spent by U.S. consumers on food suggests that little generality is lost by assuming that $\partial c_1/\partial E = 0$.[1]

National income (I) is the sum of payments to the mobile factor of production and quasi-rents to the sector-specific factors of production:

$$(5) \qquad I \equiv \sum_{i=1}^{2} K_i \, \pi_i(p_1, w) + wL \, .$$

The traded goods are processed versions of the intermediate goods that are ready for export. Let y_a and y_b be the quantities of the traded agricultural and nonagricultural commodities, respectively. For simplicity, the process of converting the intermediate agricultural and nonagricultural products into final exports delivered to the foreign country is represented by the constant returns to scale technologies:

$$(6) \qquad y_a = \alpha y_1$$

$$y_b = \beta y_2 .$$

This technology is assumed to include transportation and marketing services for trade which otherwise leave the commodity unchanged.[2]

International demands for commodities a and b are given by the foreign excess demand functions:

$$q_i = q_i(p_a^*/p_b^*) \qquad (i = a,b).$$

Here p_i^* represents the price of commodity i in the foreign country. It is assumed throughout that $q_i(\cdot)$ is an excess demand function such that $q_b' > 0$ and $q_a' < 0$. (Again to avoid complicating the model we have presumed foreign income effects are negligible.)

Equilibrium

All markets are perfectly competitive. This assumption may appear strong given the Schmitz et al. allegation that the international grains market is characterized by quasi-monopolistic traders. The assumption is made for three reasons. It allows isolating the effects of export subsidies without confounding them with the effects of monopolistic practices by international middlemen. Thus, if a policy is found to affect farmers adversely it can be attributed to the policy and not the actions of the middlemen. If farmers cannot gain in the presence of competitive middlemen, they are even less likely to gain with noncompetitive middlemen. Second, Bieri and Schmitz; McCalla; Alaouze, Watson, and Sturgess; and Chambers and Woolverton have already analyzed the implications of various policy alternatives in the presence of international grain cartels and quasi-monopolistic traders. In particular, Chambers and Woolverton have shown that the institution of a grain cartel could hurt farmers. Third, the grain traders maintain that they are low mark-up pricers making their profits on volume and not price manipulation. Caves presents empirical evidence supporting this claim. This characteriza-

tion fits the technology described by (6) above.

The equilibrium conditions for the model in the absence of government intervention are:

Mobile factor

$$\sum_{i=1}^{2} K_i \frac{\partial \pi_i(p_i, w)}{\partial w} = -L$$

Intermediate goods

$$K_1 \frac{\partial \pi_1(p_1, w)}{\partial p_1} = c_1(p_1, p_2, E) + ay_a$$

$$K_2 \frac{\partial \pi_2(p_2, w)}{\partial p_2} = c_2(p_1, p_2, E) + by_b$$

Traded goods

(7)
$$y_a = q_a(p_a^*/p_b^*)$$

$$y_b = q_b(p_a^*/p_b^*)$$

International middlemen

$$p_a y_a - p_1 ay_a = 0$$

$$p_b y_b - p_2 by_b = 0$$

Budget Constraint

$$E = I$$

where $a = 1/\alpha$, and $b = 1/\beta$.

The first equation in (7) is the equilibrium condition for the mobile factor of production in the home country. The second and third equations state that domestic production of the intermediate goods equals demand by

domestic consumers for the intermediate goods plus the derived demand by international middlemen for the intermediate goods. The fourth and fifth equations are the market-clearing conditions for the traded goods sectors. The next two equations are the zero-profit conditions required by free entry and exit of middlemen. The last is the domestic consumer budget (balance of trade) constraint.

The equation system in (7) has ten unknowns:

$$(p_1, p_2, p_a, p_b, p_a^*, p_b^*, w, E, y_a, y_b).$$

Absent government intervention, however, competitive behaviour insures that $p_i = p_i^*$ $(i = a,b)$.[3] There are enough equations to solve for all the unknowns.

To develop the relationship between p_a and p_b and p_1 and p_2 substitute the final-good production functions (6) into the middleman's zero-profit conditions. The price of the intermediate goods 1 and 2 equals the price of the corresponding final good times α and β, respectively: middlemen are mark-up pricing. Use the equilibrium conditions in the traded goods market to incorporate the foreign excess demands into the equilibrium conditions for the intermediate goods. Income can be substituted for E in the demand functions by the budget constraint. Thus, the system of equations is reduced to a three-equation system plus the international price linkages:

$$(8) \qquad K_1 \frac{\partial \pi_1(\alpha p_a, w)}{\partial w} + K_2 \frac{\partial \pi_2(\beta p_b, w)}{\partial w} = -L$$

$$K_1 \frac{\partial \pi_1(\alpha p_a, w)}{\partial p_1} - c_1(\alpha p_a, \beta p_b, I) - a q_a(p_a^*/p_b^*) = 0$$

$$K_2 \frac{\partial \pi_2(\beta p_b, w)}{\partial p_2} - c_2(\alpha p_a, \beta p_b, I) - bq_b(p_a^*/p_b^*) = 0 \ .$$

The homogeneity properties of demands and supplies imply one price can be selected as the numeraire. Let w be the numeraire and real-prices $\bar{p}_i = p_i/w$, $\bar{p}_i^* = p_i^*/w$ (i = a,b), and $\bar{I} = I/w$. All purchasing power and prices, therefore, are measured in terms of units of L. With little loss of generality, all normalized prices are assumed initially to equal one.

Cash Export Subsidies

Although the general equilibrium effects of export subsidies are well understood, they are briefly reviewed here to permit easy comparison with the PIK subsidy results.

Introducing cash export subsidies for the traded agricultural commodity requires modifying the price-linkage between the domestic and foreign markets. The real per unit subsidy is denoted $\bar{s}$ (we presume that initially $\bar{s} = 0$). The relationship between domestic and international prices is then:

$$\bar{p}_a^* = \bar{p}_a - \bar{s}.$$

A cash export subsidy must be financed out of domestic income. Equation (5) is modified to read in normalized terms:

$$(9) \qquad \bar{I} = K_1 \ \pi_1(\alpha\bar{p}_a, 1) + K_2 \ \pi_2(\beta\bar{p}_b, 1) + L - \bar{s}y_a.$$

The first three terms give the real income earned by factors of production, and the last term is the real export subsidy cost .

The effects of introducing this subsidy are captured by:

$$(10) \qquad \frac{\partial \bar{p}_a}{\partial \bar{s}} = \frac{1}{\Delta}\left[K_2 \ \partial_{wp} \ \pi_2 \ \beta(aq_a') \right]$$

$$\frac{\partial \bar{p}_b}{\partial \bar{s}} = -\frac{1}{\Delta}\left[K_1\ \partial_{wp}\ \pi_1\ \alpha(aq'_a)\right]$$

where

$$\Delta = K_1\ \partial_{wp}\ \pi_1\ \alpha\left(aq'_a - c_{12}\ \beta\right) - K_2\ \partial_{wp}\ \pi_2\ \beta\left(K_1\ \partial_{pp}\ \pi_1\ \alpha - c_{11}\ \alpha - aq'_a\right).$$

Here the notation $\partial_{ij}\ \pi_k$ means the second partial derivative of π_k with respect to price i and price j.

The profit function $\pi_i(\ )$ is convex in p and w. Hence $\partial_{pp}\ \pi_i$ is non-negative. The homogeneity and convexity of π_i imply $\partial_{wp}\ \pi_i < 0$. With only two consumption goods complementarity is excluded. The terms c_{ij} $(j = 1,2)$ are thus the Hicksian-demand slopes (recall $\partial c_i/\partial E = 0$) and hence are of opposite signs with $c_{11} < 0$ and $c_{12} > 0$. Thus, Δ is unambiguously positive.

Inspection of the numerators in (10) now yields unambiguous results: $\partial \bar{p}_a/\partial \bar{s} > 0$ and $\partial \bar{p}_b/\partial \bar{s} < 0$. The real domestic price of the traded agricultural good rises while $\bar{p}_b$ falls. (Qualitative results are summarized in Table 1.) Consequently, the price of the agricultural intermediate good rises, and the price of the intermediate nonagricultural good falls.

World market prices react differently than domestic prices. The export subsidy lowers the border price of the agricultural good facing the foreign country. (Note the first expression in (10) is less than one.) The foreign country's border price for the nonagricultural good also falls as $\bar{p}_b$ falls because there is no policy intervention in this market. Consequently, trade expands because the excess demands of the foreign country have negative slopes.

The effect of the cash export subsidy on real sectoral income can now be easily inferred. Because $\bar{p}_a$ and $\bar{p}_i$ both rise, the properties of π_i imply that

real farm income rises with the cash export subsidy. (Recall total real income to the i^{th} specific factor is $K_i \pi_i(\bar{p}_1, 1)$ which is nondecreasing in $\bar{p}_1$.) On the other hand, because $\bar{p}_2$ falls real nonagricultural income falls. The real income of the mobile factor, L, falls relative to farm income and rises relative to nonagricultural income. Farmers benefit from a cash export subsidy given to the international middleman, while nonfarmers lose.

In-Kind Export Subsidy to Farmers

In modeling in-kind subsidies to farmers, the in-kind subsidy amount is not considered a portion of current supply or demand. It only consists of accumulated government stocks. As was true when the EEP was initiated, these stocks are initially assumed isolated from the market and not price sensitive. Moreover, we assume initially that these stocks do not comprise a portion of current flow income of the government. (Both assumptions are relaxed below.) Thus, the in-kind subsidy yields a rightward shift in intermediate agricultural-commodity supply. The analysis, reminiscent of trade growth models, therefore focuses solely on the consequences of an in-kind export subsidy to which farmers have first title and not on a PIK program where PIK payments compensate producers for retiring acreage.

Denoting the in-kind subsidy as PIK, the intermediate agricultural market-clearing condition is respecified:

$$(11) \qquad PIK + K_1 \frac{\partial \pi_1(\bar{p}_1, 1)}{\partial p} = c_1(\bar{p}_1, \bar{p}_2, \bar{I}) + ay_a .$$

Introducing a PIK subsidy is analyzed by differentiating the new equilibrium conditions and evaluating all derivatives at PIK = 0 to get:

$$(12) \qquad \frac{\partial \bar{p}_a}{\partial PIK} = \frac{K_2}{\Delta} \partial_{wp} \pi_2 \beta < 0;$$

$$\frac{\partial \bar{p}_b}{\partial PIK} = \frac{-K_1}{\Delta} \partial_{wp} \pi_1 \alpha > 0.$$

The real price of the traded agricultural commodity falls while the traded nonagricultural commodity real price rises. Contrast this with the cash export subsidy result where $\bar{p}_a$ rises and $\bar{p}_b$ falls. The cash and PIK export subsidies have opposite effects! To see why notice that the PIK induced rightward shift in agricultural supply makes the agricultural price fall to soak up the resulting excess supply at original prices. The real nonagricultural price rises to divert demand from the nonagricultural commodity to the agricultural commodity. As a result of these price adjustments, $\bar{p}_1$ falls while $\bar{p}_2$ rises. These latter real prices movements imply that the real rental rate on the agricultural-specific factor ($\pi_1(\bar{p}_1, 1)$) falls while $\pi_2(\bar{p}_2, 1)$ rises. Agriculture's share in earned national income falls relative to that of the mobile factor and to the owners of the nonagricultural-specific factor. Again contrast this with the results for a cash subsidy.

As the real prices of the agricultural traded and intermediate goods fall, so do commercial (non-government stock) exports of the traded agricultural commodity. Total agricultural exports rise because of the lower world price of the traded agricultural good relative to the nonagricultural good. Noncommercial (PIK) exports actually displace commercial agricultural exports.

Although $\pi_1(\bar{p}_1, 1)$ falls, farmers may not lose because the PIK subsidy is made directly to them. Because farmers have title to the PIK amount, a necessary condition for their real total income to rise as a result of introducing a PIK payment is:

$$(13) \qquad \frac{\partial(\bar{p}_1)}{\partial PIK} \cdot \frac{PIK}{(\bar{p}_1)} > \frac{-PIK}{y_1}.$$

Expression (13) illustrates that when total demand for the intermediate agricultural commodity is very price inelastic, introducing a PIK subsidy to farmers causes a large fall in $\bar{p}_1$. The induced effect on farm income is both large and negative. For farmers to gain from the subsidy, the PIK amount must be large relative to farm production. In contrast, when total demand for the intermediate agricultural commodity is very elastic the PIK subsidy acts as a virtual lump-sum transfer to farmers and tends to raise their incomes.

That a PIK export subsidy to farmers can make farmers worse off apparently has not been clearly understood. Granting the PIK export subsidies to farmers has much the same effect as exogenous growth in a traditional trade model.[4] There growth, via an increased endowment or technical change, causes an adverse terms of trade shift which counters the gain from the output expansion (Dixit and Norman). If the worsening terms of trade effect is large enough to dominate the gain from increased output, national welfare falls -- growth is "immiserizing." Whether growth is immiserizing is governed by the elasticities of the model. Here, however, the PIK subsidy always deteriorates the terms of trade which in turn always adversely affects the export sector (agriculture). On balance, this adverse trade effect outweighs the PIK giveaway if (13) is not satisfied.

In-Kind Subsidy to Exporters

Now consider what happens when the PIK subsidy is paid directly to international middlemen. Three recent analyses consider this type of subsidy. Houck examines a general export bonus scheme where the in-kind payment is tied to commercial exports (also see below). Hillberg and Seitzinger and Paarlberg model EEP in a bargaining theoretic framework. None of these studies consider the general equilibrium consequences of such PIK subsidies.

When the EEP was announced in spring 1985, great care was taken to prevent domestic resale of the PIK subsidies. Sales were targeted at specific countries and in-kind subsidies were only granted to companies which had already made sales agreements with importing nations. The attempt to shield domestic markets from a PIK export subsidy was not new. Starting in 1956, a PIK payment to subsidize wheat and flour exports had been available to exporters from CCC stocks. Certificates redeemable for CCC stocks were made available to exporters upon proof of exports from private wheat stocks; but the wheat taken from CCC stocks could only be sold for export (Cochrane and Ryan).

The EEP provisions and the 1956 PIK program suggest that whether a PIK grant to exporters can be resold domestically has important consequences. But it is easy to show that the fungible nature of internationally traded commodities makes such export provisions irrelevant: the same equilibrium conditions emerge whether exporters can resell the PIK grant domestically or not (Chambers and Paarlberg). Here, we only consider a PIK grant which must be exported.

Consider a PIK export subsidy given to the exporting companies which must be exported. The equilibrium condition for the intermediate agricultural good remains the same, but y_1 must now be interpreted as purchases by the trading firms for "commercial" exports. The equilibrium condition for the traded agricultural good must be modified to reflect the PIK subsidy. Total exports now equal "commercial" exports plus PIK exports:

$$(14) \qquad q_a(p_a^*/p_b^*) = \alpha(PIK + y_1).$$

Because the exporting companies sell the PIK but only buy y_1 on the domestic market, their zero profit condition becomes:

(15) $$p_a \alpha(PIK + y_1) - p_1 y_1 = 0$$

Solving (14) and (15) recursively gives:

(16) $$y_1 = aq_a - PIK$$

(17) $$p_1 = \frac{\alpha\, p_a q_a}{q_a - \alpha\, PIK}$$

Substituting (16) into the intermediate agricultural goods market clearing condition gives the following equilibrium conditions:

(18) $$K_1 \frac{\partial \pi_1}{\partial p_1} = c_1 + aq_a - PIK$$

$$\sum_{i=1}^{2} K_i \frac{\partial \pi_i}{\partial w} = -L$$

$$p_1 = \frac{\alpha\, p_a q_a}{q_a - \alpha\, PIK}$$

Normalizing all prices by w and choosing units such that initially $p_a/w = p_b/w = a = 1$ and $PIK = 0$ gives the following comparative static expression:

(19) $$\begin{bmatrix} 1 & -1 & 0 \\ K_1\, \partial_{wp}\, \pi_1 & 0 & K_2\, \partial_{wp}\, \pi_2\, \beta \\ K_1\, \partial_{pp}\, \pi_1 - c_{11} & -q_a' & q_a' - c_{12}\, \beta \end{bmatrix} \begin{bmatrix} d(\bar{p}_1) \\ d(\bar{p}_a) \\ d(\bar{p}_b) \end{bmatrix} = \begin{bmatrix} \frac{1}{q_a} \\ 0 \\ 1 \end{bmatrix} dPIK \ .$$

The first row of (19) (and the last in (18)) shows that the simple linear link between $\bar{p}_1$ and $\bar{p}_a$ is now broken. The effect on $\bar{p}_1$ of a PIK subsidy given to middlemen has two parts:

(20) $$\frac{d(\bar{p}_1)}{dPIK} = \frac{d(\bar{p}_a)}{dPIK} + \frac{1}{q_a} \ .$$

The first part, through $\bar{p}_a$, emerged in the previous subsidy cases: the PIK subsidy to farmers and the cash export subsidy. To see the origin of the second term recall the following: an in-kind subsidy to exporters enables them to take a smaller return on each commercial sale than before and still break even. While $\bar{p}_a$ is expected to fall as a result of the subsidy (indeed this is shown later), the secondary effect can ameliorate and under suitable conditions even overcome the first effect.

Solving (19) gives (at $\alpha = 1$):

$$(21) \qquad \frac{\partial(\bar{p}_a)}{\partial PIK} = -\frac{1}{q_a}\frac{K_2\partial_{wp}\pi_2\beta[(c_{11} - K_1\partial_{pp}\pi_1) - q_a] + K_1\partial_{wp}\pi_1(q_a' - c_{12}\beta)}{K_2\partial_{wp}\pi_2\beta[(c_{11} - K_1\partial_{pp}\pi_1) + q_a'] + K_1\partial_{wp}\pi_1(q_a' - c_{12}\beta)}$$

$$(22) \qquad \frac{\partial(\bar{p}_b)}{\partial PIK} = \frac{1}{q_a}\frac{K_1\partial_{wp}\pi_1[(c_{11} - K_1\partial_{pp}\pi_1) - q_a] + K_1\partial_{wp}\pi_1[K_1\partial_{pp}\pi_1 - c_{11} - q_a']}{K_2\partial_{wp}\pi_2\beta[(c_{11} - K_1\partial_{pp}\pi_1) + q_a'] + K_1\partial_{wp}\pi_1(q_a' - c_{12}\beta)}$$

$$= -\frac{1}{q_a}\frac{K_1\partial_{wp}\pi_1[q_a + q_a']}{K_2\partial_{wp}\pi_2\beta[(c_{11} - K_1\partial_{pp}\pi_1) + q_a'] + K_1\partial_{wp}\pi_1(q_a' - c_{12}\beta)} .$$

The sign of (21) is always negative. A PIK subsidy to middlemen also has the opposite effect of a cash subsidy on $\bar{p}_a$. The sign of (22) is positive if the foreign excess demand for the agricultural traded good is inelastic. This is true because the denominator of (22) is positive by earlier arguments while the numerator's sign depends upon the expression $-[q_a + q_a']$. Because all prices are normalized to unity initially, this expression is $-q_a[1 + \eta]$ where η is the elasticity of excess demand (q_a'/q_a). If excess demand is inelastic, (22) is positive (recall $K_1\,\partial_{wp}\,\pi_1$ is negative). (This assumes $q_a > 0$, the home country is a net exporter of a.)

Intuitively, an inelastic agricultural excess demand implies that the PIK induced supply shift yields little quantity adjustment but relatively large

declines in $\bar{p}_a$. This result translates into reduced foreign expenditure for agricultural products which means greater expenditures on nonagricultural products and higher prices for b. If $\bar{p}_b$ rises, i.e., $-(1 + \eta) < 0$ quasi-rent to the nonagricultural-specific factor rises (p_2/w remains linearly related to p_b/w).

A necessary and sufficient condition for $\bar{p}_1$ to rise is:

$$\frac{1}{q_a}\left(q_a \frac{d(\bar{p}_a)}{dPIK} + 1\right) > 0.$$

From above $d(\bar{p}_a) < 0$. A necessary and sufficient condition for $(\bar{p}_1)$ to rise is that the numerator of the right-hand side of (21) be less than the denominator. But the only differences between the terms is the presence of $(-q_a)$ in the numerator and q'_a in the denominator. Hence, $(\bar{p}_1)$ rises only if excess demand for the traded agricultural commodity is elastic. This is similar to Houck's result obtained when p_1 is a blend of the commercial and subsidized prices. If excess demand for the agricultural traded good is inelastic, a PIK subsidy to middlemen causes $\bar{p}_1$, and thus, $\pi_1(p_1, 1)$ to fall. Real farm income falls not rises. Farmers are hurt not helped by the PIK subsidy.

These results permit determining the effects of introducing a PIK export subsidy on commercial exports. Commercial exports of the traded agricultural commodity are:

$$\text{(23)} \qquad \text{Commercial exports} = q_a(p_a^*/p_b^*) - \text{PIK} .$$

Expression (23) implies the following necessary and sufficient condition for introducing a PIK subsidy to exporters to raise commercial exports

$$(24) \qquad q'_a\left(\frac{d(\bar{p}_a)}{dPIK} - \frac{d(\bar{p}_b)}{dPIK}\right) > 1 \ .$$

Substituting from equations (21) and (22) into (23) yields after a slight rearrangement of terms:

$$(25) \qquad \frac{-q'_a}{q_a}\left[\frac{K_2\partial_{wp}\pi_2\beta(c_{11} - K_1\partial_{pp}\pi_1 - q_a) + K_1\partial_{wp}\pi_1(-c_{12}\beta - q'_a)}{K_2\partial_{wp}\pi_2\beta(c_{11} - K_1\partial_{pp}\pi_1 + q'_a) + K_1\partial_{wp}\pi_1(q'_a - c_{12}\beta)}\right] > 1 \ .$$

Because the denominator of (25) is positive, the condition for commercial exports to rise is

$$(26) \qquad -(1 + \eta)[K_2\,\partial_{wp}\,\pi_2\,\beta(c_{11} - K_1\,\partial_{pp}\,\pi_1) - K_1\partial_{wp}\,\pi_1\,c_{12}] > 0 \ .$$

The term in square brackets on the left hand side of (26) is positive. Thus commercial exports fall if excess demand is inelastic, $-(1 + \eta) > 0$.

The assumption of zero trader profit implied by pure competition is important to the results in this section. Suppose, to the contrary, that traders only need a zero profit on their commercial sales and are allowed to retain the value of the PIK amount as a lump-sum transfer. In this case, the equilibrium conditions are the same as for an in-kind subsidy to farmers. But now farmers always lose because they see falling prices and incomes and derive no income from the PIK amount. This intuition suggests that the less competitive is the international grains market, the more likely it is that a PIK subsidy will hurt farmers.

Export Subsidies and a Target Price

The results presented above examine the impact of cash export and in-kind subsidies without considering other policies. But trade policies usually operate in concert with other interventions. In the United States agricultural producer prices are often guaranteed by setting high target prices which

become the effective producer price. In this context, an export subsidy is often the trade manifestation of the domestic intervention. Hillberg, for example, shows that the levels of U.S. domestic policy instruments are critical in empirically evaluating EEP.

To examine the sensitivity of results to domestic policy, the subsidy policies are reanalyzed in the presence of a real target price set above the market clearing equilibrium price and maintained by deficiency payments. Price-support operations though a nonrecourse loan program are considered separately below.

In this section the effective producer price for the intermediate agricultural good is the real target price which is policy determined and is unchanged by the subsidy program.[5] If $\bar{p}_1$ is above the real target price, the analysis proceeds as before. Only cases where the target price is effective are of interest. The real target price is assumed fixed. If only the nominal price is fixed (the more usual case), then the real producer price of the intermediate good would be free to vary as in earlier sections.

Domestic real income available for consumption is income less the deficiency payment cost:

$$\bar{I} = \sum_{i=x}^{2} K_i \frac{\partial \pi_i(\bar{p}_i, 1)}{\partial w} + L - (\bar{p}_1^s - \bar{p}_1)\, y_1 .$$

where $\bar{p}_1^s$ is the real target price. Differentiating the mobile-factor market equilibrium gives:

$$(27) \qquad K_1\, \partial_{wp}\, \pi_1\, d\bar{p}_1^s + K_2\, \partial_{wp}\, \pi_2\, \beta d\bar{p}_b = 0 .$$

With the real target price fixed, $d\bar{p}_1^s = 0$, and hence from (27) $d\bar{p}_b = 0$. An export subsidy, therefore, causes no change in domestic relative producer

prices. Hence, the export subsidy no longer affects the allocation of L. And, because endowments of K_1 and K_2 are fixed, the export subsidy has no effect on domestic production patterns. This result implies, in turn, that the price of the nonagricultural traded good and its intermediate counterpart cannot change. Therefore, with a fixed real target price, all adjustment comes in terms of the domestic consumption price and the price to foreign buyers of the agricultural intermediate and its traded counterpart.

A cash export subsidy's impact on the tradeable agricultural good's real price to consumers and foreigners is:

$$\frac{d\bar{p}_a}{d\bar{s}} = \frac{aq'_a}{c_{11}\,\alpha + aq'_a}$$

The denominator is clearly negative because it contains own price effects from domestic and excess demand. The numerator is also negative. Thus, $\bar{p}_a$ rises in response to the cash subsidy. As above, however, $d\bar{p}_a/d\bar{s} < 1$, the domestic price of the agricultural commodity rises by less than the subsidy amount and the price abroad falls.

The rise in $\bar{p}_a$ induces an increase in $\bar{p}_1$, which reduces domestic demand for the intermediate agricultural good. Because the producer price is fixed at $\bar{p}_1^s$, no production change occurs. No matter what happens producers continue to receive the target price. With static production and falling domestic consumption exports of the agricultural good must rise. (This also can be seen by noting that $\bar{p}_a^*$ falling causes an expansion of trade.) Producer income and the returns to sector specific factors are the same as before the subsidy policy. A cash export subsidy in the presence of a fixed real target price only acts to increase agricultural exports, it does not improve agriculture's position in the national economy. Subsidy rents are transferred

to foreign consumers.

With an in-kind subsidy to farmers the associated change in $\bar{p}_a$ is:

$$(28) \qquad \frac{d\bar{p}_a}{dPIK} = (c_{11}\,\alpha + aq'_a)^{-1}.$$

Expression (28) shows that $\bar{p}_a$ falls in response to the in-kind subsidy. This price decline is necessary to absorb the additional supply of government stocks placed on the market. Total exports are greater as $\bar{p}^*_a$ is also lower.

The consumer price of the agricultural intermediate good also falls. Domestic use of the intermediate rises. Since production is unchanged with the fixed target price and domestic use is greater, "commercial" exports are lower both as a share of total exports and in absolute volume. As before, commercial exports are displaced by exports from released government stocks.

With $\bar{p}^s_1$ constant sector-specific factor prices remain unchanged by the policy. However, the income of agricultural producers now clearly rises as their volume marketed expands by the amount PIK, which is sold at price $\bar{p}_1$. Agriculture, therefore, gains as a result of the export subsidy.

When the in-kind subsidy is given to the international middleman,

$$\frac{d\bar{p}_a}{dPIK} = \frac{\left(-1 + c_{11}\,\frac{\alpha}{y_1}\right)}{-(c_{11}\,\alpha + aq'_a)}$$

which is negative. Because $\bar{p}_a$ falls and there is no price wedge in the world market, $\bar{p}^*_a$ falls and total exports rise. With the real target price constant producers of the intermediate agricultural commodity experience no changes in this policy environment. Subsidy benefits are transferred to domestic and foreign consumers.

Considering the in-kind subsidy to the middleman without the target price, the change in $\bar{p}_1$ is ambiguous. This result occurs because of the conflict between the negative terms of trade effect and the positive direct effect. A similar situation holds here. The change in $\bar{p}_1$ faced by domestic consumers is

$$\frac{d\bar{p}_1}{dPIK} = \frac{\alpha\left(1 + q'_a \frac{a}{y_1}\right)}{(c_{11}\,\alpha + aq'_a)}.$$

If excess demand for the tradeable agricultural good is elastic, total exports increase enough to increase the domestic consumption price of the intermediate good. This occurs because the increase in total trade requires an increase in commercial exports which can only be met through a reduction in domestic use. If the excess demand is not elastic, then the change in the domestic price of the intermediate agricultural good depends on the ratio of total trade to commercial trade -- $aq_a(\cdot)/y_1$. Larger in-kind subsidies will raise this ratio by lowering y_a, and hence, will be more likely to raise $\bar{p}_1$.

Tied PIK Export Subsidies[6]

So far, all PIK export subsidies have been lump-sum. While this specification closely approximates the EEP type of PIK subsidy other forms of PIK subsidies are possible. This section considers PIK subsidies tied to the level of agricultural exports. Only the case where the PIK subsidy is granted to farmers is analyzed. The reader can easily extend the analysis to the case where the PIK subsidy is granted to exporters using previous developments.

Let τ denote the percent of total exports comprised by the PIK subsidy, i.e.,

$$PIK = \tau\, q_a.$$

This necessitates the following respecification of (11)

$$(11') \qquad K_1 \frac{\partial \pi_1(\bar{p}_1, 1)}{\partial p} = c_1(\bar{p}_1, \bar{p}_2, \bar{I}) + (a - \tau)y_a \ .$$

Differentiating the new equilibrium conditions and evaluating all derivatives at $\tau = 0$ gives the following effects of introducing a PIK subsidy tied to total exports:

$$(29) \qquad \frac{\partial \bar{p}_a}{\partial \tau} = \frac{q_a K_2 \partial_{wp} \pi_2 \beta}{\Delta}$$

$$\frac{\partial \bar{p}_b}{\partial \tau} = \frac{-q_a K_1 \partial_{wp} \pi_1 \alpha}{\Delta}$$

Comparing (29) with (12) reveals that a tied export PIK subsidy granted to farmers has the same qualitative effects as a lump-sum export PIK subsidy granted to farmers. (This presumes, of course, that when the PIK subsidy is granted the subsidizing country exports the agricultural commodity, i.e., $q_a > 0$.)

A Longer Run View[7]

Thus far, granting the PIK subsidy has had no effect on current national income because a PIK subsidy is assumed to enter the national income accounts as either transfers from the government to farmers or to exporters. The effect on national income is a wash unless the demand functions are specified to take income distributional issues into account. A primary justification for this specification is that the original EEP program used stocks accumulated in historical periods by the government. Current flow income was not affected by those transfers. But this analysis ignores an important point. The EEP has not been a one-time export subsidy program. Rather it evolved

into an ongoing program extending over at least the life of the Food Security Act of 1985.

If all EEP subsidies were granted from government stocks accumulated before the institution of EEP, the analysis would proceed as before. But current EEP subsidies are drawn from government stocks continuously acquired through the government's price-support (typically nonrecourse loan) operations. These price-support operations, in turn, are affected by the PIK-subsidy program. As PIK-subsidies drive market prices down more stocks are acquired through forfeited loans. This has two effects: the price-support operations mitigate the degree to which agricultural prices fall as a result of the PIK subsidy and the government incurs additional budgetary expenses out of current flow income to support market prices.

To assess the longer run consequences of an export PIK subsidy, therefore, the government's price-support operations must be incorporated into the analysis. A nonrecourse loan program is introduced in which the government agrees to purchase all commodities offered at a guaranteed price -- the loan rate. The CCC regularly acquires stocks of supported agricultural commodities at prices above the loan rate (even after corrected for interest costs etc.). Therefore, current government acquisitions of stocks are assumed to be governed by $i(p_1/p_\ell)$ where p_ℓ is the loan rate. We make the following assumptions:

$$i'(k) < 0$$

and

$$\lim_{k \to 1} i'(k) = -\infty.$$

The first assumption means that government accumulation of inventories through forfeited loans declines as p_1 rises relative to the loan rate. The second

assumption means that CCC stands ready to buy all of the commodity offered to it at the loan rate: as the market price approaches the loan rate, government demand for inventories becomes perfectly elastic.[8]

These price-support operations are introduced into preceding analyses. The most obvious change is that expression (5) must be rewritten to recognize the effect loan defaults have on flow income:

$$(5') \qquad I = \sum_{i=1}^{2} K_i \, \pi_i(p_1, w) + wL - p_\ell \, i(p_1/p_\ell).$$

The other change is that the intermediate agricultural good equilibrium must be changed to reflect the new source of government demand for the commodity. Hence, rewrite that condition as:

$$K_1 \frac{\partial \pi_1(p_1, w)}{\partial p_1} = c_1(p_1, p_2, E) + i(p_1/p_\ell) + ay_a.$$

The first step is to analyze how the comparative static effects of a cash export subsidy change as a result of the price-support operations. The necessary calculations give the following results:

$$(10') \qquad \frac{\partial \bar{p}_a}{\partial \bar{s}} = \frac{K_2 \, \partial_{wp} \, \pi_2 \beta \, (q_a' \, a)}{\Delta \, (p_1/p_\ell)}$$

$$\frac{\partial \bar{p}_b}{\partial \bar{s}} = - \frac{K_1 \, \partial_{wp} \, \pi_1 \alpha \, (q_a' \, a)}{\Delta \, (p_1/p_\ell)}$$

where

$$\Delta(p_1/p_\ell) = \Delta + \frac{K_2 \, \partial_{wp} \, \pi_2 \beta \, i'(\bar{p}_1/\bar{p}_\ell) \cdot \alpha}{\bar{p}_\ell}$$

By earlier results, $\Delta(p_1/p_\ell) > \Delta$. And by the assumptions on $i(p_1/p_\ell)$ it follows that

$$\lim_{k \to 1} \Delta(k) = \infty.$$

Therefore, as expected, allowing for price-support intervention dampens the price responsiveness to export subsidies in both markets. In the limit, where the market price is "riding" the loan rate, a cash subsidy has no effect on market prices. Because both $\bar{p}_a$ and $\bar{p}_b$ change less than in the absence of price-support intervention, a cash export subsidy is less effective in raising farm income in the presence of a price-support program than in its absence. In contrast, nonfarm prices (and nonfarm income) fall less than in the absence of such programs.

Turning to a PIK export subsidy given to farmers,

$$(12') \qquad \frac{\partial \bar{p}_a}{\partial PIK} = \frac{K_2 \, \partial_{wp} \, \pi_2 \beta}{\Delta(p_1/p_\ell)}$$

$$\frac{\partial \bar{p}_b}{\partial PIK} = \frac{-K_1 \, \partial_{wp} \, \pi_1 \alpha}{\Delta(p_1/p_\ell)}$$

Again we conclude that price-support programs dampen the price response to the PIK program. Real agricultural prices fall less than they would have in the absence of the price-support program and real nonagricultural prices rise less. As the initial p_1 approaches the loan rate, a PIK program given to farmers has no price effect in either agricultural or nonagricultural markets. And, in general, because $\bar{p}_1$ falls less than in the absence of price support, it is more likely, *ceteris paribus,* that a PIK subsidy to farmers raises total farm income when a price-support program exists. The price-support operations dampen the adverse terms of trade effect caused by the PIK subsidy.

The effect on total government inventories consists of two parts: the PIK giveaway and the reaccumulation of inventories through the price-support

mechanism. The expression for the total effect is:

$$(30) \qquad \frac{i'(\bar{p}_1/\bar{p}_\ell)\ \alpha K_2\ \partial_{wp}\ \pi_2\ \beta}{\bar{p}_\ell\ \Delta(p_1/p_\ell)} - 1$$

Using (10′) and (12′) implies that expression (30) is always nonpositive. A PIK export subsidy given to farmers always ends with the government not increasing commodity stocks. The long-run implication is that, *ceteris paribus*, an export PIK given to farmers eventually dissipates the government's inventories as less and less beginning inventory is available each period to subsidize exports.

As the initial market price approaches the loan rate the first term in (30) approaches unity. Therefore, if the market price is "riding the loan rate" when the PIK giveaway is instituted, all the PIK commodity given away is immediately reabsorbed through the government's price-support operations. In this limiting case, the PIK giveaway acts as a pure lump-sum transfer program to farmers. Farmers receive a lump-sum transfer equalling $p_\ell \cdot$PIK. Under these circumstances the demand faced by farmers is perfectly elastic as the CCC buys everything that is offered at p_ℓ. Thus, expression (13) is satisfied.

Finally, consider how a price-support program changes the results for a PIK export subsidy granted to exporting companies. Performing the appropriate comparative-static manipulations gives (at $\alpha = 1$):

$$(21') \qquad \frac{\partial \bar{p}_a}{\partial PIK} = -\frac{1}{q_a}\ \frac{[K_2\partial_{wp}\pi_2\beta(c_{11} + i'(\bar{p}_1/\bar{p}_\ell)/\bar{p}_\ell - K_1\partial_{pp}\pi_1 - q_a) + K_1\partial_{wp}\pi_1(q_a' - c_{12}\beta)]}{\Delta(p_1/p_\ell)}$$

$$(22') \qquad \frac{\partial \bar{p}_b}{\partial PIK} = -\frac{1}{q_a} \frac{K_1 \, \partial_{wp} \, \pi_1 (q_a + q_a')}{\Delta (p_1 / \bar{p}_\ell)}$$

By (22′) the price response in the nonagricultural traded goods market is dampened by the introduction of the price-support operations. However, while the traded agricultural good price still falls as a result of the PIK export subsidy, it is ambiguous whether it falls by more or less than in the absence of the price-support program. However, in the limit as p_1 approaches the loan rate, $\bar{p}_a$ falls $(-1/q_a)$ units for every unit of the PIK subsidy. But as (20) verifies, this last result implies that $\bar{p}_1$ does not change and consequently neither does farm income in this limiting case. Total farm income remains constant. So, in the case which most closely approximates the 1985 situation (market prices riding the loan rate and PIK subsidies given to exporters), farmers realize no gain from the PIK subsidy. Instead, the export PIK subsidy to exporters ends as a lump-sum transfer to domestic and foreign consumers (absent a competitive grains market, it would be a lump-sum transfer to exporters).

Conclusions

This paper demonstrates the differences between cash and in-kind export subsidies. These results are summarized in Table 1. Cash export subsidies expand exports by raising domestic prices and lowering the world price. The price of the agricultural product in the subsidizing country rises, thereby, benefiting farm producers at the expense of consumers and taxpayers. An in-kind subsidy given to farmers lowers the price received by farmers but expands total farm exports. The PIK commodities displace commercial exports. Although real farm production income is lower after the PIK, farmers are not

necessarily worse off because the in-kind payment is made directly to them. When international excess demand is elastic farmers may gain from the introduction of PIK payments. An in-kind export subsidy given to competitive international middlemen lowers the world price and expands trade. The effect of the subsidy on farmers is ambiguous. If the excess demand for the agricultural good is elastic, then agriculture's share of national income rises. For an inelastic excess demand, farm income falls.

Analysis of these three subsidy alternatives in the presence of an effective target price leaves most of the results unchanged. However, with the producer price determined by the target price, producer income is not altered by cash export subsidies and in-kind subsidies to international traders. When the in-kind payment is made directly to farmers producer income is unambiguously higher with an effective target price.

When a price support program is in effect, the impacts of such subsidies are dampened. Government inventories are reduced by in-kind subsidies over the long-run. Further, the analysis shows when the market price approaches the loan rate, the PIK subsidy given to farmers becomes a lump sum subsidy, while the cash and in-kind subsidy to traders leave farm income unaffected. The PIK commodities given away are immediately reabsorbed through the government's price support operations.

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Footnotes

1. This assumption is made mainly to sharpen the analysis and reduce notational clutter. All of the results that follow generally are ambiguous if income effects on the agricultural good are allowed. However, so long as these effects are small, which empirical evidence (George & King) suggests is the case, they will be dominated by the more direct price effects discussed below.
2. More generally some would argue strongly that fixed costs associated with processing are large, e.g., grain for export. This could be incorporated into the present model by replacing (6) with a quasi- homothetic technology. Expression (6) can also be easily generalized to include competitively provided inputs for a more general production structure without seriously affecting the analysis.
3. The analysis assumes, unlike the 1956 situation but approximately like the 1985 situation, that the domestic and world prices are the same.
4. We owe this interpretation to an anonymous reviewer.
5. Implicitly we assume all producers are "in the program."
6. We would like to thank an anonymous reviewer for suggesting the analysis contained in this section.
7. This analysis was suggested to us by an anonymous reviewer.
8. Similar specifications are embedded in the FAPRI and Wheatsim policy models.

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Table 1: Effects of Alternative Subsidies

	Without Target Price or Loan Rate						With Target Prices					
	$\bar{p}_a$	$\bar{p}_b$	$\bar{p}_1$	$\bar{p}_2$	$\pi_1(\bar{p}_1, 1)$	Total Real Farm Income	$\bar{p}_a$	$\bar{p}_b$	$\bar{p}_1$	$\bar{p}_2$	$\pi_1(\bar{p}_1, 1)$	Total Real Farm Income
Cash export subsidy	+	-	+	-	+	+	+	0	+	0	0	0
PIK to farmers	-	+	-	+	-	?	-	0	-	0	0	?
PIK to middlemen	-	?	?	?	?	?	-	0	?	0	0	?

	With Loan Rates					
Cash export subsidy	+	-	+	-	+	+
PIK to farmers	-	+	-	+	-	?
PIK to middlemen	-	?	?	?	?	?