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A Theory of Nonprice Export Promotion with Application to USDA's Subsidy Programs

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Preface

This research was sponsored by a grant from the National Institute for Commodity Promotion Research and Evaluation (NICPRE). NICPRE has sponsored approximately eight to ten projects such as this one each year since its inception. The overall purpose of projects sponsored by NICPRE is to increase understanding of issues in the area of commodity promotion economics. NICPRE will continue to publish the findings from these projects as NICPRE Research Bulletins.

Harry M. Kaiser
Director

Introduction

This paper focuses on the relationship between subsidies for nonprice export promotion and private sector investment in promotion. Specifically, we address whether federal subsidies for nonprice export promotion have any detectable effects on the total investment in promotion and on budget allocations. The allocation issue is particularly germane because federal outlays to support agricultural industries in their nonprice export promotion endeavors increased from $34 million in 1985 to $232 million in 1992 (Kinnucan and Ackerman, p. 123). One possible outcome of the increased subsidies is that industry dollars are merely diverted from domestic market promotion to

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export market promotion with no enlargement in total spending, in which case a negative spillover occurs in the domestic promotion program. The nexus between subsidies for export promotion and domestic market promotion has heretofore gone unrecognized in the literature.

Knowledge of the relationship between promotion subsidies and promotion expenditures is important because nonprice promotion is one of the few policy instruments available to government to influence agricultural exports. Traditional instruments such as export price subsidies and credit guarantees are no longer permissible under recent trade agreements (GATT and NAFTA). Increased reliance on export markets signalled by new farm legislation (Gardner), coupled with the "green box" designation of nonprice export promotion activities (McCleod), suggests that foreign market development may play a larger role in future formulations of agricultural policy.

We begin by developing a theory of nonprice export promotion for a competitive industry that has no control over price or quantity, has a checkoff program that permits it to promote, and receives a subsidy for export promotion. The analysis builds on Nerlove and Waugh's theory of cooperative advertising by extending their model to include an export market. It differs from Ding and Kinnucan's model of export promotion in that emphasis is placed on the promotion subsidy, rather than on farm programs *per se*, as a determinant of promotion behavior. Hypotheses generated from the model are tested utilizing data for 50 agricultural industries that had a checkoff program in 1989, a year in which funding of USDA's export subsidy programs was at a near peak. The empirical analysis suggests that USDA's subsidy programs have had a stimulative effect on promotion expenditures, but that most of the effect is felt in the domestic rather than export market.

Theory and Hypotheses

Consider a competitive industry that produces an exportable homogenous product and receives a subsidy of τ dollars per dollar of its own funds invested in export promotion. Assume that the industry has a checkoff program that generates an annual promotion budget equal to A^o dollars. The industry's problem is to allocate A^o between the export and the domestic market in such a way that producer surplus is maximized, taking into account the subsidy for export promotion. Specifically, the industry's problem is to maximize the following Lagrange function L with respect to A_x, A_d, and λ:

(1) $$L = P_d\, Q_x\, (P_d, A_x(1+\tau)) + P_d\, Q_d(P_d, A_d) - \int_0^{Q_s} S^{-1}(t)\, dt + \lambda(A^o - A_x - A_d)$$

where A_x is total industry expenditures on export promotion (exclusive of the subsidy); A_d is total industry expenditures on domestic promotion; P_d is the price received by domestic producers, which is assumed to equal the world price (the law-of-one-price holds); Q_x is the quantity exported; Q_d is the quantity consumed domestically; Q_s $(= Q_x + Q_d)$ is domestic production; S^{-1} is the industry supply function written in inverse form, i.e., price as a function of quantity; and λ is the Lagrange multiplier.

The first order conditions pertaining to (1) are:

$$\partial L/\partial A_x = Q_s\ \partial P_d/\partial A_x - \lambda = 0$$

$$\partial L/\partial A_d = Q_s\ \partial P_d/\partial A_d - \lambda = 0$$

$$\partial L/\partial \lambda = A^o - A_x - A_d = 0,$$

which, when converted to elasticities and solved for A_x, A_d and λ, yield the following optimality conditions (see appendix):

(2) $$A_x^* = A^o\, K_x\, B_x \,/\, [K_x\, B_x + (1 + \tau)^{-1}\, K_d\, B_d\,]$$

(3) $$A_d^* = A^o\, K_d\, B_d \,/\, [(1 + \tau)\, K_x\, B_x + K_d\, B_d\,]$$

(4) $$\lambda^* = P_d\, Q_s\, (K_d\, B_d + K_x\, B_x\, (1 + \tau)) \,/\, (A^o\, D)$$

where $D = (E_d + K_d N_d + K_x N_x) > 0$; E_d is the supply elasticity; N_x and N_d are demand elasticities for the product in the export and domestic markets, respectively, expressed in absolute value form; K_d is the proportion of domestic production consumed at home; K_x (= 1 - K_d) is the proportion of domestic production exported; B_x is the percent change in exports per 1 percent change in export promotion expenditures, i.e., the export promotion or "advertising" elasticity; and B_d is the advertising elasticity for domestic promotion.

Several hypotheses are immediately apparent from (2) - (4). First, supply and demand elasticities, which are important in determining the marginal profitability of the overall promotion program, have no bearing on allocations decisions (compare equations (2) and (3) with (4)). Second, the subsidy for export promotion has two effects: it encourages industry to divert funds away from domestic market promotion to export promotion (compare equations (2) and (3)); and it provides an incentive for industry to invest more *in toto* in promotion (notice the subsidy parameter in the numerator of (4)).

Additional insight into the relationship between subsidy and the budget can be obtained by solving (4) for A^o in terms of τ, which yields:

(4') $$A^o = P_d\, Q_s\, (K_d\, B_d + K_x\, B_x\, (1 + \tau)) \,/\, (\lambda^*\, D)$$

Interpreting A^o as the outcome of a first stage decision problem, it is immediately apparent from (4') that industry will be induced to a higher level of promotion, *ceteris paribus*, as the subsidy for export promotion becomes more generous. If the first stage decision problem is solved optimally, i.e., in a manner that maximizes producer surplus, then $A^o = A^*$, and, as shown by Nerlove and Waugh (p. 822), $\lambda^* = 1 + \rho$, where ρ is the opportunity cost of advertising funds.

Note that the optimal advertising budget A^* is based on a purely economic theory of cooperative advertising, and for this reason represents a theoretical upper bound. In reality, cooperative advertising programs must take into account political factors, such as the lobbying efforts of individuals or groups who may be opposed to the advertising scheme. In addition, as emphasized by Nerlove and Waugh (p. 820), assessment rates must be kept low enough so that the program can be approved by the majority of producers. For protected industries (e.g., dairy and cotton), advertising-induced shifts in demand may have little effect on price at the farm level, in which case the incentive to promote may be weakened (Kinnucan, Duffy, and Ding). If programs are voluntary, free-riders further diminish the ability to fund the program at the theoretical optimum. Thus, in general $\lambda^* > 1 + \rho$ and $A^o < A^*$.

Returning to the allocation problem, an essential aspect of the foregoing theory for the purposes of this analysis is that subsidy indirectly affects allocations through its effect on budget size. To examine the indirect effect in more detail, substitute (4') into (2) and (3) and write the resulting equations in implicit form:

$$A_x^* = A_x\,(A^*(A_G, \boldsymbol{Z_1}), A_G, \boldsymbol{Z_2})$$

$$A_d^* = A_d\,(A^*(A_G, \boldsymbol{Z_1}), A_G, \boldsymbol{Z_2})$$

where A_G is the subsidy for export promotion in dollar terms, i.e., $A_G = \tau A_x$; $\boldsymbol{Z}$ is a vector of variables governing the investment decision, i.e., $\boldsymbol{Z_1} = (P_d Q_s, E_d, N_d, N_x, \rho, B_d, B_x, K_x, \boldsymbol{PE})$; $\boldsymbol{Z_2}$ is a vector of variables affecting the allocation decision, i.e., $\boldsymbol{Z_2} = (B_d, B_x, K_x)$; and $\boldsymbol{PE}$ is a vector of "political economy" variables that determines the extent to which A^o deviates from A^*. Taking the total differential of these expressions with respect to A_G yields:

(5) $$\underset{(+)}{dA_x^*/dA_G} = \underset{(+)}{(\partial A_x^*/\partial A^o)}\underset{(+)}{(\partial A^o/\partial A_G)} + \underset{(+)}{\partial A_x^*/\partial A_G}$$

(6) $$\underset{(?)}{dA_d^*/dA_G} = \underset{(+)}{(\partial A_d^*/\partial A^o)}\underset{(+)}{(\partial A^o/\partial A_G)} + \underset{(-)}{\partial A_d^*/\partial A_G}$$

where the subsidy's indirect effects on budget allocations are represented by the compound terms $(\partial A_x^*/\partial A^o)(\partial A^o/\partial A_G)$ and $(\partial A_d^*/\partial A^o)(\partial A^o/\partial A_G)$. These indirect effects are important because they condition the signs and magnitudes of the total effects. In particular, in the case of export allocation (equation (5)), the indirect effect has the same sign as the direct effect $(\partial A_x^*/\partial A_G)$, and thus the two effects are mutually reinforcing.

For the domestic allocation (equation (6)), the indirect effect works in opposition to the direct effect, and thus the total effect is *a priori* indeterminate. Thus, the spillover effect of the subsidy onto domestic market promotion is an empirical issue. For there to be a positive spillover, the derivative $\partial A^o/\partial A_G$, which measures the subsidy's "budget-expansion effect," must be positive. Thus, a key issue to be addressed in this study is whether USDA's subsidy programs induce industry to invest more *in toto* in promotion.

USDA's Subsidy Programs

To test the foregoing hypothesis, it is necessary first to have an understanding of how the subsidy programs work. The USDA operates three programs germane to this analysis: the Foreign Market

Development (FMD) program, the Export Incentive Program (EIP), and the Market Promotion Program (MPP), recently renamed the Market Access Program (MAP). The FMD program, which was established in 1954 as part of PL480, is aimed chiefly at bulk commodities (e.g., cotton, feedgrains, wheat), emphasizes long-term market development, and is almost exclusively generic. The EIP was established in 1971 specifically to support the promotion of branded agricultural products (e.g., Dole, Sunkist, Blue Diamond). EIP funds are directed toward consumer-ready high-value products (e.g., raisins, almonds, walnuts). EIP's emphasis is on short-term sales gains through consumer promotions.

MPP, by far the largest of the three, was established in 1985 as the Targeted Export Assistance (TEA) program to "...aid U.S. producers disadvantaged by foreign trade policies" (Spatz, p.3). Regulations governing MPP were subsequently modified to expand participation by small firms and to emphasize market access over retribution for unfair trade practices (Ackerman and Kinnucan, p.122). The MPP is in essence a hybrid of FMD and EIP, providing funds for both generic and brand promotions, and for bulk as well as high-value (consumer-ready) products. Total authorized funding for the three programs peaked in 1992 at $233.6 million, with the bulk of the funds ($200 million) dispersed through MPP and EIP (Kinnucan and Ackerman, p. 123).

To participate in the programs, an industry association submits a marketing plan to USDA's Foreign Agricultural Service (FAS). The marketing plan must indicate objectives, target markets, promotion strategy, and budget. The budget indicates the total expected cost of the proposed promotion activity, and how that cost is to be shared among the domestic industry, the U.S. government, and foreign third-party cooperators, such as foreign firms or governments that agree to participate in the promotion effort on a cost-share basis.

Depending on the private sector resource commitment and FAS's assessment of the marketing plan, subsidies are awarded according to program regulations. Nonbrand MPP participants, for example, are eligible to receive up to \$9 for each industry dollar invested; brand MPP participants, in contrast, generally receive at most \$1 per industry dollar (Kinnucan and Ackerman, p. 122). In 1989, the ratio of government dollars to industry dollars averaged 2.5:1 and the ratio of government dollars to foreign third-party dollars averaged 1.38:1 for the 50 industries considered in this study (Table 1).

Model

To test whether the subsidies provided through USDA's programs had any detectable effect on total promotion expenditures, and to determine how the subsidies affect allocation decisions, we estimated a four-equation recursive model as follows:

Budget Equation:

$$\ln A_i = \alpha_0 + \alpha_1 AG^e_i + \alpha_2 \ln FV_i + \alpha_3 PRN_i + \alpha_4 \ln ETA_i + \alpha_5 XSHR_i + \alpha_6 TRDSHR_i + \alpha_7 MAND_i + \alpha_8 PS_i + \epsilon_i \tag{7}$$

Cooperator Equation:

$$ATP_i = \beta_0 + \beta_1 XVAL_i + \beta_2 XVAL_i^2 + \beta_3 XSHR_i + \beta_4 TRDSHR_i + \beta_5 FMD_i + \beta_6 EIP_i + \mu_i \tag{8}$$

Subsidy Equation:

$$AG_i = \gamma_0 + \gamma_1 ATP_i + \gamma_2 ATP_i^2 + \gamma_3 XVAL_i + \gamma_4 XVAL_i^2 + \gamma_5 XSHR_i + \gamma_6 TRDSHR_i + \gamma_7 \ln NF_i + \upsilon_i \tag{9}$$

Allocation Equation:

$$(10)\qquad AX_i = \delta_0 + \delta_1 ATP_i + \delta_2 ATP_i^2 + \delta_3 AG_i + \delta_4 AG_i^2 + \delta_5 A_i + \delta_6 A_i^2 + \delta_7 \ln ETA_i + \delta_8 XSHR_i + \delta_9 TRDSHR_i + \xi_i$$

where I indexes the industry (I = 1,2,...,50); α, β, γ, and δ are vectors of parameters to be estimated; ϵ_i, μ_i, υ_i and ξ_i are random disturbance terms; A_i, ATP_i, AG_i and AX_i are the endogenous variables in the system; and the remaining variables are exogenous (see Table 1 for definitions).

The foregoing system assumes that export expenditures are the product of a four-stage (sequential) process. In the first stage (equation (7)), the industry determines its total promotion budget A_i based on the theoretical factors defined in the $\boldsymbol{Z}_I$ vector given earlier and the anticipated export promotion subsidy AG_i^e. The anticipated subsidy, in turn, is assumed to be a least-squares projection of past subsidies as follows:

$$(7a)\qquad AG_i^e = a_o + a_1 AG88_i + a_2 AG87_i + a_3 AG86_i + u_i$$

where AG^e_i is the predicted subsidy for 1989 from a Tobit estimator of (7a) when the residual u_i is zero (see Table 1 for variable definitions).

In the second stage (equation (8)), the industry seeks funding from foreign third-party cooperators. Cooperator funding is assumed to be a nonlinear function of the commodity's export value, and a linear function of the export share, the trade share, and past program participation, i.e., whether the cooperator has participated in the MPP, EIP, or FMD.

Once cooperator funding is determined, the industry applies for the subsidy (equation (9)). The subsidy is assumed to be a linear function of export share and trade share, and a nonlinear function of cooperator funding, export value, and the number of producers represented by the industry. The number of producers is included to control for any preferences that might be given to smaller industries in the allocation of subsidy dollars.

The final stage (equation (10)) involves allocating the budget determined in the first stage to export promotion, taking into account the cooperator funds and subsidy secured in the intermediate stages. The export allocation decision is determined by the variables in the $\boldsymbol{Z_2}$ vector defined earlier, with the domestic demand elasticity and the trade share serving as proxies for advertising elasticities. Theil posits that advertising elasticities are proportional to demand elasticities (see also Wohlgenant, pp. 647-48); hence the justification for using the domestic demand elasticity to proxy the domestic promotion elasticity. Export demand elasticities become less elastic as trade share increases; thus the use of the trade share as a proxy for the export promotion elasticity.[2]

Data and Estimation Procedures

The data used to estimate (7) - (10) are based on 50 agricultural industries that had commodity promotion programs in 1989 as identified by Forker and Ward (pp. 102 - 103).[3] These industries received approximately $150 million in FMD, EIP and MPP funds in 1989, which equals 65 percent of the appropriated funds ($230 million) for that year and 87 percent of actual expenditures ($172 million). The data on promotion budgets (A_i) are for the most recent fiscal year prior to January

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[2] The formula for the excess demand elasticity is (McCloskey, p. 144): $N_x = (Q_D / Q_x) N + (Q_S / Q_x) E_{row}$ where Q_D is the *total* quantity demanded in the export market; N is the *market* demand elasticity (in absolute value) from all sources (United States, its competitors, and local production); Q_S is the quantity supplied to the export market by countries other than the United States; and E_{row} is the supply elasticity for "rest of world" supply. Since *TRDSHR* $\underset{x}{=}$ Q_D/Q by definition, it is obvious from this formula that N_x decreases as *TRDSHR* increases.

[3] Forker and Ward's list actually includes 55 industries. Our sample excludes the following: canned and processed foods, seafood, chocolate, leather, wood, and ginseng.

1990 as reported in Forker and Ward's Table 5-1 (pp. 102-03).

Data on subsidies (*AG_i*), third-party expenditures (*ATP_i*), and industry expenditures for export promotion (*AX_i*) were obtained from internal USDA records made available to us by Wendell Dennis and Denise Fetters of the FAS. These data were used to define the dummy variables for FMD and EIP participation (*FMD_i* and *EIP_i*). Data on mandatory programs (*$MAND_i$*) were obtained from Neff and Plato in addition to the authors' personal knowledge of the industries. The price-support variable (*PS_i*) was defined according to whether support was *effective* during the sample period (e.g., soybeans are considered unsupported because the target price during 1987-89 was below the market price).

Data on domestic demand elasticities (*ETA_i*) were obtained from George and King (pp. 46-52). In instances where an elasticity estimate was not available, a value of 0.50 was used, which is approximately the average elasticity value estimated for the 49 commodities covered by George and King's study.

Data on export share (*$XSHR_i$*), trade share (*$TRDSHR_i$*), farm value (*FV_i*), and farm numbers (*NF_i*), which are averages for 1987-89, were obtained from a variety of government and industry sources, including FAS statistical databases made available to us by Earnest Carter of the FAS. (A data appendix, with sources, is available upon request from the authors.) Mean values and ranges are given in Table 1.

Forty percent of the industries in our sample did not receive subsidies in 1989 and thus are presumed not to have engaged in export promotion.[4] To account for the censored nature of the

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[4] Although industry may invest in export promotion without benefit of subsidy, we could find no evidence to indicate that this happens in practice. In particular, a recent survey of commodity promotion organizations indicated that among those industries that invested in export promotion, all had received subsidies (Lenz).

dependent variables in (8) - (10), the models were estimated using a maximum-likelihood Tobit estimator. Equation (7), which is specified in double-log form to accommodate the wide variation in the dependent variable ($90,000 - $209 million), was estimated by Generalized Least Squares utilizing White's consistent estimator (Greene, pp. 249-50) to correct for heteroskedasticity. Unless indicated otherwise, a *t*-statistic based on a one-tail test at the 5 percent probability level is used to establish statistical significance.

Results

The results are satisfactory overall in that the R^2s, which range from 0.51 for the cooperator equation to 0.81 for the subsidy equation, are high for cross-section data, and many of the estimated coefficients are significant and have the right sign. Prior to examining the subsidy impacts in detail, we briefly review each equation.

Budget Equation

The budget equation "explains" 67 percent of the variation in commodity promotion budgets across the sample's 50 industries. As expected, promotion budgets are positively related to commodity value and are larger under mandatory programs than voluntary programs. Perennial crops have larger promotion budgets, *ceteris paribus*, than nonperennials, a result consistent with *a priori* expectations in that supply elasticities are expected to be smaller for perennials and thus promotion more profitable, *ceteris paribus*.

Budget appears to be unrelated to the domestic demand elasticity, the export share, or whether the industry is protected by a price support program. The lack of significance of the price support variable suggests that protection does not necessarily reduce the incentive to promote. This finding is important because it suggests that producers consider more than short-term gains when deciding on whether or not to invest in cooperative promotion endeavors. It highlights the caveat raised by Nerlove and Waugh that a theory of cooperative advertising based strictly on economic considerations may not fully explain fully promotion budgets. The estimated coefficient for trade share, which serves as a proxy for the export promotion elasticity, is negative as expected.

Turning to expected subsidy, AG_i^e (the key policy variable in the budget equation), we find to be positive and significant, as expected.[5] The estimated coefficient, 0.1162, indicates the effect of a one dollar increase in the expected subsidy on the *logarithm* of the promotion budget. To convert this coefficient to natural numbers, we multiplied it by the mean value of the promotion budget as indicated in Table 3, which yields a numerical value of 1.54.[6] This means that a one dollar increase in the anticipated subsidy is associated with an increase in the total promotion budget of \$1.54. Thus, it appears that the subsidy has a substantial budget expansion effect. Stated another way, the hypothesis that the subsidy merely diverts funds from domestic market promotion with no enlargement in industry's total investment in promotion is rejected by these data.

Perspective on the relative magnitude of the estimated budget expansion effect can be obtained by recalling that in 1989, domestic industry received on average \$2.50 in government funds per dollar of its own funds. Viewed in this way, the marginal effect of the subsidy (1.54) is less than the average effect (2.50), as would be expected if budgets were in the profitable range.

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[5] The estimated regression used to compute AG_i^e is as follows (figures in parentheses are asymptotic *t*-ratios):

$$AG^e_i = -0.7074\ (2.45) + 0.4286\ (4.23)\ AG88_i + 0.3094\ (2.59)\ AG87_i + 0.7945\ (5.34)\ AG86_i + 1.3408\ (7.66)\ \sigma_i \qquad R^2 = 0.949$$

where σ_i is the variance term from the Tobit estimator and the R^2 is from the OLS equation. Note that the sum of the lagged coefficients (1.53) indicates that a dollar increase in past subsidies is associated with an expected increase in current subsidy of greater than one dollar. This probably reflects the implementation of TEA in 1985 and the subsequent quintupling of subsidies over the next five years from \$40 million to \$230 million (Kinnucan and Ackerman, p. 123).

[6] That this is appropriate is seen by noting that $d\ln A = dA/A$. Thus, in equation (7), $\partial \ln A/\partial AG^e = \alpha_1$, which implies $\partial A/\partial AG^e = \alpha_1 A$.

Cooperator Equation

The cooperator equation "explains" 51 percent of the variation in third-party funds among the 50 industries. Third-party funds increase at a decreasing rate with respect to export value, are positively related to trade share, and are unrelated to export share. FMD participants receive \$4.46 million more in third-party funds, *ceteris paribus*, than MPP participants, the excluded category. This result, coupled with the insignificance of EIP_i, is consistent with the fact FMD participants receive a more generous subsidy, on average, than EIP or MPP participants, owing to the almost exclusively generic nature of FMD promotion activities. Recall that generic advertisers receive up to \$9 in subsidy per industry dollar invested, while brand advertisers are limited, generally, to \$1 per dollar invested. In 1990 TEA/MPP was 34 percent brand while FMD was 1 percent brand (Mackie, p. 21). EIP, by law, is 100 percent brand.

Subsidy Equation

The subsidy equation, with an R^2 of 0.81, has the highest explanatory power of any equation in the system. All estimated coefficients have the expected sign and most are significant. Promotion subsidies are positively related to export share, trade share, export value, and foreign third-party funds. The quadratic term for export value is negative, indicating that subsidy increases with export value, but at a decreasing rate.

A similar relationship appears to exist between subsidy and third-party funds, as the linear term is positive and the quadratic term is negative. The marginal effect of third-party funds on subsidy capture, evaluated at data means (see Table 3), is 0.68.[7] This means that each additional

[7] The marginal effects from a Tobit model (equations (8)-(10)) are computed by multiplying the model's regression coefficients by the probability of a nonlimit response. The probability of a nonlimit response estimated for each equation is given in Table 3.

dollar secured in third-party funds is matched, at the margin, by 68 cents in government funds, *ceteris paribus*.

The number of farmers represented by a commodity has no effect on subsidy capture, as the lnFN_i variable is insignificant. Thus, it appears that no particular favoritism is bestowed on smaller industries with respect to the allocation of federal promotion subsidies.

Allocation Equation

Fifty-eight percent of the variation in export expenditures among the 50 industries can be "explained" by the variables specified in the allocation equation. However, among the variables specified, only subsidy is significant. One interpretation of this result is that the theory elucidated earlier lacks explanatory power. A more plausible explanation, however, is that the regression suffers for the "dominate variable" problem, to wit (Rao and Miller, pp. 40-41):

> In many empirical studies theory tells us unambiguously that a particular variable is relevant in explaining movements of the dependent variable, but it cannot be included in the regression equation because it is a *dominant* variable. Such a variable dominates all other variables in the regression and attempts to account for all of the variation in the dependent variable, leaving nothing to be explained by other variables. This situation frequently occurs in empirical research where the dependent variable is somehow functionally related to an independent variable in "fixed proportions."

In our application, cost-sharing formulae applicable to the subsidy programs suggest a functional relationship between export promotion expenditures and subsidy, implying a dominant variable problem. To test this, we re-labeled equation (10) Model A and estimated two alternative versions. One version, Model B, deletes the subsidy variables. The other version, Model C, retains only the subsidy variables.

Results confirm the dominant-variable hypothesis. In particular, when the subsidy variables are deleted from the allocation equation, the remaining variables have the correct sign and most are significant at the 10 percent level or lower (compare Models A and B, Table 3). Similarly, regressing export expenditures on subsidy exclusively results in little loss in "explanatory" power (compare Models A and C). Moreover, the estimated coefficients for subsidy in Models A and C are similar, which suggests that multicollinearity is not the cause of the "insignificant" variables in Model A. Based on these results, we accept the dominant-variable explanation for Model A's results and proceed by utilizing Model B when discussing nonsubsidy impacts.

Results suggest that export promotion expenditures are positively related to budget size, subsidy, third-party funds, the absolute value of the domestic demand elasticity (our proxy for the domestic promotion elasticity), and export share. However, the last two of these variables, along with trade share, are not significant at usual probability levels. The negative coefficients associated with the quadratic terms for budget, subsidy, and third-party funds suggest the monies devoted to export promotion increase at a decreasing rate with respect to these variables.

The marginal effects of third-party funds, subsidy, and budget on export promotion expenditures, evaluated at data means, are indicated in Table 3. Not surprisingly, we find that the marginal effect of the subsidy (0.52) is much larger than the marginal effect of either third-party funds (0.23) or budget (0.07). The especially small marginal effect for budget suggests that industry's propensity to invest in export promotion is low, a finding that has important implications for the indirect effects of subsidy to be discussed presently.[8]

[8] That industry is reluctant to invest in export promotion is hardly surprising, given the presence of close substitutes for U.S. agricultural commodities in international markets and the attendant free-rider problem (Goddard and Conboy).

Policy Implications

One goal of the USDA's subsidy programs is to expand industry investment in export promotion. To determine how effective the programs have been in accomplishing this objective, and to determine the spillover effect of the subsidy programs on domestic market promotion, we calculated the total effects of the subsidy utilizing equations (5) and (6) and the appropriate numerical values of the partial derivatives in Table 3 as follows:

$$dA_x^*/dA_G = (\partial A_x^*/\partial A^o)(\partial A^o/\partial A_G) + \partial A_x^*/\partial A_G$$

$$0.6210 = (0.0678)(1.5412) + 0.5165$$

$$dA_d^*/dA_G = (\partial A_d^*/\partial A^o)(\partial A^o/\partial A_G) + \partial A_d^*/\partial A_G$$

$$0.9202 = (0.9322)(1.5412) - 0.5165.$$

According to these calculations, it appears that the subsidy programs have achieved their intended purpose. In particular, a dollar increase in subsidy is associated with a 62.1 cent increase in industry investment in export promotion when the indirect effect of the subsidy (10.5 cents) is taken into account. The marginal effect of a dollar increase in budget, by comparison, is a mere 6.8 cents. Thus, it appears that subsidies are an important factor in determining the total industry investment in export promotion. In other words, given industry's apparent reluctance to commit budget at the margin to export promotion, it appears that very little cooperative promotional activity would occur in export markets without the inducements offered by the USDA's subsidy programs.

Turning to the spillover effect, we find that the subsidy has a positive effect on domestic market promotion. In particular, a dollar increase in subsidy increases domestic market promotion an estimated 92.0 cents. That the spillover effect is positive can be traced to the subsidy's indirect effect, which is relatively large owing to the positive budget-expansion effect (1.54) and a high propensity to allocate budget to domestic market promotion (0.93) in preference to export market promotion (0.07). Multiplying these factors produces an indirect effect of $1.44, which is more than sufficient to offset the subsidy's direct effect of - $0.52. Thus, far from diverting funds from the domestic promotion program, the subsidy appears to enlarge domestic market promotion by encouraging industry to invest more *in toto* in promotion.

Concluding Comments

The theory of nonprice export promotion developed in this paper suggests that subsidies for export promotion provide incentives to invest more in export promotion, less in domestic promotion, and more in promotion *in toto*. The key issue, then, is: do promotion subsidies targeted at the export market have beneficial effects overall, or are they merely redistributive, robbing Peter to pay Paul? Investigating this question with respect to the federal subsidy programs aimed at the agricultural sector, our empirical analysis is affirmative. That is, we find that a dollar increase in the anticipated subsidy induces industry to expand its total promotion budget by an estimated $1.54, with 60 percent of the increment (92 cents) going to domestic market promotion and 40 percent (62 cents) going to export promotion.

Although our results suggest that the USDA's subsidy programs have had a stimulative effect on promotion expenditures in both the domestic and the export market, we caution that this does not necessarily imply that the subsidy programs are beneficial from a social welfare perspective. That depends on whether the subsidies do indeed cause identifiable shifts in market demand or supply schedules, on who gets the subsidies, and on opportunity costs. Subsidies given to protected industries, for example, may be welfare-decreasing in that resources may be attracted away from more efficient, unprotected industries (DeBoer). Similarly, if the opportunity cost of funds invested in promotion (e.g., returns from foregone production research) is high, the subsidies may lead to a net reduction in producer welfare (Wohlgenant). Still, if the goal is simply to increase private sector investment in export promotion without doing damage to domestic market promotion, it appears that the subsidy programs have been highly effective.

A caveat in interpreting our results is that the estimates are based on a time period (1986-89) in which subsidies were expanding rapidly and many promotion programs (42 percent) were voluntary. This, coupled with the generosity of the subsidies, especially for generic-based promotions, may account for the large estimated budget-expansion effect. Since then, subsidies have become less generous due to funding cuts, and most promotion programs have become mandatory. With mandatory programs, industry has less flexibility in responding to subsidy-based incentives. Thus, it would be hazardous to use the total effects estimated in this study to predict the effect of subsidy reductions. In particular, with the current preponderance of mandatory programs, one would not expect budgets to decline at the same rate as they increased when subsidies were expanding and many more programs were voluntary. The irreversibility of promotion budgets in the mandatory era, however, does not subtract from the basic conclusion that export promotion subsidies appear to have had a significant expansionary effect on nonprice promotion activity in the agricultural sector.

Table 1. Variable Definitions and Summary Statistics, 50 Agricultural Commodities, United States, 1989

Variable	Definition	Mean Value	Range
Endogenous Variables:			
A_i	Total promotion budget for *i*th commodity, million dollars	13.263	0.09 - 209.1
ATP_i	Foreign third-party funds received by *i*th commodity for export promotion, million dollars	2.126	0 - 28.23
AG_i	Government funds received by *i*th commodity for export promotion, million dollars	2.944	0 - 19.63
AX_i	Domestic industry expenditures for export promotion by *i*th commodity, million dollars	1.177	0 - 7.851
Exogenous Variables:			
$AG88_i$	Gov't funds received by *i*th commodity in 1988, million dollars	2.516	0 - 19.05
$AG87_i$	Gov't funds received by *i*th commodity in 1987, million dollars	1.357	0 - 10.44
$AG86_i$	Gov't funds received by *i*th commodity in 1986, million dollars	2.019	0 - 11.02
FV_i	Farm value of *i*th commodity, billion dollars	2.673	.0125 - 35.76
$XSHR_i$	Export share for *i*th commodity, percent	17.475	0 - 71.3
$XVAL_i$	Export value for *i*th commodity, billion dollars	0.451	0 - 4.80
$TRDSHR_i$	World trade share for *i*th commodity, percent	25.512	0 - 87.3
ETA_i	Demand elasticity for *i*th commodity, absolute value	0.505	0.14 - 1.56
NF_i	Number of farmers producing *i*th commodity, thousands	71.894	0.07 - 1,141

PRN_i	Zero-one variable to indicate whether *i*th commodity is a perennial	0.46	0 - 1
PS_i	Zero-one variable to indicate whether *i*th commodity has a price support program	0.18	0 - 1
$MAND_i$	Zero-one variable to indicate whether *i*th commodity's checkoff program is mandatory	0.58	0 - 1
FMD_i	Zero-one variable to indicate whether the *i*th commodity received funding from Foreign Market Development program	0.34	0 - 1
EIP_i	Zero-one variable to indicate whether the *i*th commodity received funding from Export Incentive Program	0.04	0 - 1

Table 2. GLS Estimates of Budget Equation and Tobit Estimates of Cooperator, Subsidy, and Allocation Equations, 50 U.S. Agricultural Industries, 1989 Data

Variable/ Statistic	Budget Equation[a]	Cooperator Equation	Subsidy Equation	Allocation Equation		
				Model A	Model B	Model C
AG_i^e	0.1162 (2.60)[b]	--	--	--	--	--
ATP_i	--	--	1.7002 (5.78)	0.0224 (0.07)	0.6739 (2.58)	--
ATP_i^2	--	--	-0.0546 (5.42)	-0.0028 (0.25)	-0.0231 (2.41)	--
AG_i	--	--	--	1.1717 (3.31)	--	1.1013 (4.89)
AG_i^2	--	--	--	-0.0398 (2.08)	--	-0.0359 (2.57)
A_i	--	--	--	0.0470 (0.58)	0.2227 (2.50)	--
A_i^2	--	--	--	-0.0004 (0.43)	-0.0021 (2.16)	--
$\ln FV_i$	0.7237 (6.35)	--	--	--	--	--
PRN_i	1.3019 (3.05)	--	--	--	--	--
$\ln ETA_i$	-0.4338 (1.01)	--	--	0.6727 (0.51)	1.9491 (1.29)	--
$XSHR_i$	-0.0010 (0.08)	-0.0767 (1.38)	0.0791 (2.51)	-0.0161 (0.58)	0.0347 (1.24)	--
$TRDSHR_i$	-0.0134 (1.89)	0.0650 (1.63)	0.0459 (2.37)	-0.0219 (1.14)	-0.0010 (0.04)	--
$MAND_i$	0.6823 (1.90)	--		--	--	--
PS_i	0.4175 (0.85)	--	--	--	--	--
$XVAL_i$	--	10.813 (3.56)	3.4736 (1.57)	--	--	--
$XVAL_i^2$	--	-1.9461 (2.97)	-0.9915 (2.51)	--	--	--
FMD_i	--	4.4605 (2.32)	--	--	--	--

EIP_i	--	2.1159 (0.48)	--	--	--	--
$\ln FN_i$	--	--	0.3103 (0.93)	--	--	--
Constant	0.2579 (0.47)	-4.4467 (2.51)	-3.8260 (3.44)	-0.7791 (0.67)	-0.9856 (0.73)	-1.8218 (2.98)
Sigma	--	4.8996 (6.74)	2.6102 (7.57)	2.3762 (7.65)	2.7911 (7.68)	2.5049 (7.73)
$\Phi(\mathbf{B'X}/s)$[c]	--	0.4653	0.4651	0.5510	0.4059	0.5597
R^2 [d]	0.677	0.514	0.806	0.579	0.408	0.521
Log-Likelihood	-73.586	-87.831	-80.625	-76.389	-81.347	-78.541

[a] Corrected for heteroskedasticity using White's estimator.

[b] Number in parenthesis is the absolute value of the asymptotic *t*-value.

[c] Probability of a nonlimit response.

[d] From OLS estimate.

Table 3. Estimated Marginal Effects of Anticipated Subsidy (AG^e), Actual Subsidy (AG), Third-Party Funds (ATP) and Budget (A), Evaluated at Data Means

Item	Formula[a]	Value
$\partial A/\partial AG^e$	$\alpha_1 A'''$	1.5412
$\partial AG/\partial ATP$	$\Phi(\gamma'\mathbf{X}/s)\ (\gamma_1 + 2\ \gamma_2\ ATP''')$	0.6827
$\partial AX/\partial ATP$	$\Phi(\delta'\mathbf{X}/s)\ (\delta_1 + 2\ \delta_2\ ATP''')$	0.2337
$\partial AX/\partial AG$	$\Phi(\delta'\mathbf{X}/s)\ (\delta_3 + 2\ \delta_4\ AG''')$	0.5165
$\partial AX/\partial A$	$\Phi(\delta'\mathbf{X}/s)\ (\delta_5 + 2\ \delta_6\ A''')$	0.0678

[a] A''' (= 13.263), ATP''' (=2.126), and AG''' (=2.944) refer, respectively, to the mean value of the promotion budget, third-party funds, and subsidy (See Table 1). Numerical values for δ_3 and δ_4 are from Model A of Table 2; values for the remaining δ_k parameters are from Model B.

Appendix: Derivation of Optimality Conditions

To begin, define the structural model as follows:

(A1) $Q_x = f(P_d, A_x(1 + \tau))$ (export demand)

(A2) $Q_d = g(P_d, A_d)$ (domestic demand)

(A3) $Q_s = S(P_d)$ (domestic supply)

(A4) $Q_s = Q_x + Q_d$ (market-clearing equilibrium).

where the quantity and price variables in (A1) - (A4) (defined in the text) pertain to initial equilibrium values. With these relationships in mind, the Lagrange function then can be written in simpler notation as:

(A5) $L = P_d\, Q_x + P_d\, Q_d - \int_0^{Q_s} S^{-1}(t)\, dt + \lambda(A^o - A_x - A_d)$.

The first order conditions are:

$$\partial L/\partial A_x = P_d\,(\partial Q_x/\partial A_x) + Q_x\,(\partial P_d/\partial A_x) + Q_d\,(\partial P_d/\partial A_x) - S^{-1}\,(\partial Q_x/\partial A_x) - \lambda = 0$$

$$\partial L/\partial A_d = P_d\,(\partial Q_d/\partial A_d) + Q_d\,(\partial P_d/\partial A_d) + Q_x\,(\partial P_d/\partial A_d) - S^{-1}\,(\partial Q_d/\partial A_d) - \lambda = 0$$

$$\partial L/\partial \lambda = A^o - A_x - A_d = 0.$$

Noting that $P_d = S^{-1}(Q_s)$ from (A3) and $Q_s = Q_x + Q_d$ from (A4), the above equations reduce to:

(A6) $\partial L/\partial A_x = Q_s\,(\partial P_d/\partial A_x) - \lambda = 0$

(A7) $\partial L/\partial A_d = Q_s\,(\partial P_d/\partial A_d) - \lambda = 0$

(A8) $\partial L/\partial \lambda = A^o - A_x - A_d = 0$,

which are equivalent to the first-order conditions equations given in the text.

Next, express (A6) and (A7) in elasticity form:

(A6') $\partial L/\partial A_x = [(Q_s\, P_d)/A_x]\ \mathbf{E}_{P\,Ax} - \lambda = 0$

(A7') $\partial L/\partial A_d = [(Q_s\, P_d)/A_d]\ \mathbf{E}_{P\,Ad} - \lambda = 0$

where $\mathbf{E}_{PAx} = (\partial P_d / \partial A_x)(A_x / P_d)$ is the reduced-form elasticity of price with respect to export promotion and $\mathbf{E}_{PAd} = (\partial P_d / \partial A_d)(A_d / P_d)$ is the reduced-form elasticity of price with respect to domestic promotion.

The task now is to derive expressions for $\mathbf{E}_{PAx}$ and $\mathbf{E}_{PAd}$ in terms of the underlying structural elasticities. For this purpose, first express the structural model in log-differential form as follows:

(A1') $\quad \mathrm{dln}Q_x = - N_x \,\mathrm{dln}P_d + B_x (1 + \tau)\, \mathrm{dln}A_x$

(A2') $\quad \mathrm{dln}Q_d = - N_d \,\mathrm{dln}P_d + B_d \,\mathrm{dln}A_d$

(A3') $\quad \mathrm{dln}Q_s = E_d \,\mathrm{dln}P_d$

(A4') $\quad \mathrm{dln}Q_s = K_d \,\mathrm{dln}Q_d + K_x \,\mathrm{dln}Q_x$

where $\mathrm{dln}Z = \mathrm{d}Z/Z$ is the relative change in variable Z and the coefficients of $\mathrm{dln}Z$ terms are as defined in the text.

Setting $\mathrm{dln}A_d = 0$ and substituting (A1') - (A3') into (A4') and solving for $\mathrm{dln}P_d$ gives the reduced-form elasticity for price with respect to export promotion:

(A9) $$\mathrm{dln}P_d / \mathrm{dln}A_x \,\big|_{\mathrm{dlnAd}=0} = \mathbf{E}_{PAx} = K_x B_x (1 + \tau) / D$$

where $D = (E_d + K_d N_d + K_x N_x)$.

The corresponding reduced-form elasticity for domestic promotion is obtained in a similar fashion by setting $\mathrm{dln}A_x = 0$:

(A10) $$\mathrm{dln}P_d / \mathrm{dln}A_d \,\big|_{\mathrm{dlnAx}=0} = \mathbf{E}_{PAd} = K_d B_d / D.$$

Substituting (A9) and (A10) into (A6') and (A7') and re-writing the resulting expressions in terms of A_x and A_d yields:

(A11) $$A_x = P_d Q_s K_x B_x (1 + \tau) / (D \lambda)$$

(A12) $$A_d = P_d Q_s K_d B_d / (D \lambda).$$

Substituting (A11) and (A12) into (A8) yields the expression for the Lagrange multiplier in equilibrium:

(A13) $$\lambda^* = P_d\, Q_s\, (K_d\, B_d + K_x\, B_x\, (1 + \tau)) \,/\, (A^o\, D),$$

which is identical to text equation (4). Text equations (2) and (3) are obtained by back substitution of (A13) into (A11) and (A12). *QED*

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