Agricultural Marketing Review of the Deparment of Agricultural
Marketing, National Chung Hsing University, Taiwan, R O.C.
No 3, March 1998, pp 257 - 272

# Determinants of Generic Advertising Effectiveness with Imperfect Competition and Trade

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**ABSTRACT**

A formula is derived to indicate the marginal returns to generic advertising when middlemen possess oligopoly power, the agricultural input is traded, and advertising funds are raised through an excise tax on agricultural output. The effect of oligopoly power on advertising profitability is *a priori* indeterminate unless marketing technology is fixed proportions, retail demand is price inelastic, or trade exposure is modest In these cases, an increase in oligopoly power enhances farm-level returns. Owing to the tax-shifting consequences of trade status, a net importer situation is more profitable, *ceteris paribus*, than a net exporter situation Application of the theory to Taiwan suggests that the most profitable commodities to promote are fruits and vegetables

**Key words : generic advertising, imperfect competition, traded goods.**

## 1. Introduction

This article focuses on the determinants of generic advertising effectiveness in an open-economy situation where price is determined under conditions of imperfect competition "Effectiveness" is defined here as the ability of generic advertising to increase producer surplus (quasi-rent) The effectiveness issue is especially germane in a small-country setting like Taiwan in that it is possible for generic advertising to have a large effect on demand and yet no effect on producer surplus The reason is that in a small-country situation, excess supply or demand curves tend to be highly elastic, meaning that advertising-induced shifts in domestic demand will have little or no effect on market price With market price constant, producer surplus in the domestic market is unaffected by the demand shift, and any benefits from the advertising flow strictly to foreign producers

Another situation where generic advertising is of dubious value to domestic producers is when the advertised commodity is protected by a price-support scheme In this case, an advertising-induced demand shift is likely simply to lower government costs with no effect on farm revenue The only exception to this rule is when advertising increases demand sufficiently to push the market price above the support price or when a price-discrimination scheme overlays a price-support scheme (e g., dairy), in which case targeted advertising of higher value products (e g , fluid milk) could raise the blend price and thus benefit producers

The protected-industry and small, open-economy problems are well-known in the commodity promotion literature (Ding and Kinnucan, Kinnucan and Belleza, Alston, Carman and Chalfant, Kinnucan (1997a)) What is less well known is how advertising rents are affected by market power Intuitively, one might expect that an increase in market power would reduce farm-level returns in that middlemen, through their price-setting ability, would retain most of the advertising rents Empirical analysis, however, suggests that this is not the case (Suzuki *et al* ) Our theoretical analysis indicates a positive relationship between oligopoly power and advertising rents provided marketing technology is fixed proportions or trade exposure is modest

The chief objective of this research is to determine the farm-level returns to retail-level demand promotion when the agricultural input is traded and middlemen possess oligopoly power The problem is of interest because governments are spending ever larger sums on generic promotion of agricultural products (e g , Table 1, p268), most agricultural products are traded (e g., Table 2, p269), and imperfect competition is a common feature of food markets (e g , Wann and Yang) [1] The analysis extends Nerlove and Waugh's theory of generic advertising by recasting their analysis in a duality framework that takes into account the marketing channel, trade, and tax incidence, i e , the cost-shifting that occurs when advertising funds are raised through a per-unit levy (Chang and Kinnucan) A key insight from the analysis is that trade offsets the rent-enhancement effects of oligopoly power

## 2.Model

Consider an imperfectly competitive industry that combines a farm-based input X with a bundle of marketing inputs M to produce a retail product Q under conditions of constant returns to scale (CRTS) Assume that X is traded Specifically, depending upon domestic supply and demand conditions, a portion of the industry's demand for X may be supplied by foreign producers Alternatively, the industry's demand for X may be satisfied entirely by domestic production $X_S$, with the excess ($X_S$ - $X_D$) exported Let this traded quantity be $X_T$

Advertising, which is directed at Q, is undertaken to benefit X-producers Specifically, the goal is to increase producer surplus in the X-market The advertising is financed, at least in part, by an excise tax on X The advertised good Q is assumed to represent a sufficiently small portion of the total economy so that the demand for and supply of related commodities can be safely ignored, at least as a first approximation [2] Imperfect competition in this industry stems from farmers' cooperatives or other institutional structures that permit middlemen to exercise oligopoly power (e g , Wann and Yang, Liu)

With the foregoing assumptions, initial equilibrium in this industry is described by the following structural model

(1) $P_r = D(Q, A)$ (retail demand)

(2) $P_r(1 - \theta/\eta) = C(P_f, P_m)$ (retail supply)

(3) $X_D = X(P_f, P_m)\,Q$ (demand for farm input)

(4) $M_D = M(P_f, P_m)\,Q$ (demand for marketing inputs)

(5) $X_S = S(P_f)$ (supply of farm input)

(6) $M_S = g(P_m)$ (supply of marketing inputs)

(7) $X_T = T(P_f)$ (trade in farm input)

(8) $X_T = X_S - X_D$ (market-clearing)

(9) $R = P_f X_S - \int_0^{X_S} S^{-1}(t)\,dt - \Omega\phi A$

(net producer surplus)

where A is advertising expenditure; $P_r$ is retail price, $P_f$ is farm price, $P_m$ is the price of marketing services, $R$ is net producer surplus at the farm level, $\theta$ is the conjectural-variation elasticity where $\theta = 0$ denotes perfect competition and $\theta = 1$ denotes pure monopoly; $\eta$ is the absolute value of the retail-level demand elasticity; and $C(\ )$ is the unit cost function under CRTS.

Equations (1) - (6) are identical in form to Holloway's model . Equations (7) and (8) account for trade in the agricultural input Equation (9) is identical to Nerlove and Waugh's rent equation except that the parameters $\Omega$ and $\phi$ are added to account for advertising cost shifting and cost sharing *Cost sharing* occurs when government provides a subsidy for promotion or an advertising tax is imposed on imports to prevent free-riding In these cases, $\phi$ indicates the X-producer share of the total advertising cost *Cost shifting* occurs when a portion of the per-unit levy is shifted to consumers in the form of higher prices. Cost shifting is likely unless the supply of X is fixed or the demand for X is perfectly elastic (Chang and Kinnucan) The $\Omega$ parameter in (9) measures the producer incidence of the promotion tax.

## 3. Analysis

Changes in retail price, quantities, and producer surplus can be approximated linearly by totally differentiating (1) - (9) and converting to elasticities and relative changes as follows

(1') $P_r^* = (-1/\eta)\, Q^* + (\beta / \eta)\, A^*$

(2') $(\eta/(\eta-\theta))\, P_r^* = \omega_f P_f^* + \omega_m P_m^* + (\theta/(\eta-\theta))\, Q^*$

(3') $X_D^* = -\omega_m \sigma P_f^* + \omega_m \sigma P_m^* + Q^*$

(4') $M_D^* = \omega_f \sigma P_f^* - \omega_f \sigma P_m^* + Q^*$

(5') $X_S^* = \epsilon_f P_f^*$

(6') $M_S^* = \epsilon_m P_m^*$

(7') $X_T^* = e\, P_f^*$

(8') $X_T^* = (X_S/X_T)\, X_S^* - (X_D/X_T)\, X_D^*$

(9') $dR = P_f X_S P_f^* - \ \Omega\phi\, dA$

where the asterisks denote relative changes (e g , $X^* = dX/X$), $\beta$ (= $(\partial Q/\partial A)(A/Q)$ is the advertising elasticity, $T_f$ and $T_m$ are cost-shares for X and M, respectively, weighted by $((\eta - \theta)/\eta)$, i e , $\omega_f = ((\eta - \theta)/\eta)\, S_f$ and $\omega_m = ((\eta - \theta)/\eta)\, S_m$ where $S_f = (P_f X)/(P_r Q)$ and $S_m = (P_m M)/(P_r Q)$ are revenue shares, respectively, for X and M, $\sigma$ is the elasticity of substitution between X and M, and $\epsilon_f$ and $\epsilon_m$ are the supply elasticities, respectively, for X and M

The $e$ parameter in (7') differs in its interpretation depending on trade status If trade status is net exporter ($X_T > 0$), then $e = e_D$ is an export demand elasticity If trade status is net importer ($X_T < 0$), then $e = e_S$ is an import supply elasticity In this study, $e_S$ is assumed to be positive and $e_D$ is assumed to be negative Specifically, the excess supply function is assumed to be non-decreasing and the excess demand function is assumed to be non-increasing

When $X_T = 0$ (autarky), equations (1') - (8') reduce to Holloway's model, which, in turn, reduces to Gardner's model when $\theta = 0$ (perfect competition) Thus, Gardner's and Holloway's models are special cases of (1') - (8') in which trade is disallowed Although not discussed by Holloway, a technical problem arises in equation (2') in that a restriction must be placed on the relative magnitudes of $\theta$ and $\eta$ to prevent division by zero In this study, we will assume that $\eta > \theta$, a plausible assumption in that a rational monopolist never operates in the inelastic portion of the demand curve ($\eta > 1$ when $\theta = 1$) and empirical estimates of market-level conjectural variation elasticities in the food sector tend to be modest (e g , Liu, Sun and Kaiser)

Following Nerlove and Waugh, A is treated as an exogenous variable Thus, the model contains nine endogenous variables (Q, $P_r$, $X_D$, $X_S$, $X_T$, $P_f$, M, $P_m$, and *R*) and one exogenous variable A Because interest centers on farm-level profit, it is sufficient to solve (1') - (9') for *R*'s reduced form. To make the reduced form intelligible, following Woghlenant (1993) we set $\in_m = \infty$ and $\in_f = 0$ Kinnucan (1997b) examined the $\in_m = \infty$ restriction in an advertising context and found it be innocuous The $\in_f = 0$ restriction implies that returns are to be interpreted as short run (one year or less for many commodities).

## 3.1 Fundamental Returns' Equation

With the foregoing assumptions, the effect of an increase in advertising on producer surplus can be determined by substituting (1') - (8') into (9') and solving for dR/dA, which yields (see appendix for derivation)

$$(10a)\quad dR/dA = MRR = \Psi^{-1}\beta/[\omega_f(\eta-\theta) + \omega_m\sigma(1-\theta) - ke(1-\theta)] - \Omega\varphi$$

where *MRR* is the net marginal return and $\Psi = A/(P_f X_S)$ is advertising expenditure divided by farm revenue, hereafter referred to as "advertising intensity"

Equation (10a) indicates the effect of a small increase in advertising expenditure taking into account market power, marketing technology, advertising cost sharing and shifting, trade exposure (*ke*), and equilibriating adjustments across domestic and international markets in response to an advertising-induced increase in the derived demand for X The net effect can be positive, negative, or zero depending on the relative magnitudes of the two terms on either side of the third negative sign in (10a) If the market is perfectly competitive ($\theta = 0$) and the agricultural input is untraded ($k = 0$), (10a) reduces to

$$dR/dA\,|_{N\text{-}W} = (\beta/\Psi\lambda) - 1,$$

where $\lambda = S_f\,\eta + S_m\,\sigma$ is the Hicks-Allen industry elasticity of derived demand The foregoing equation is identical to Nerlove and Waugh's returns' formula (p 822, equation (12)) when supply is fixed and the demand elasticity is interpreted as a derived-demand elasticity Note that Nerlove and Waugh's model implies that returns to promotion are directly related to the advertising elasticity and inversely related to advertising intensity and the absolute value of the derived-demand elasticity Similar inferences apply to (10a)

The incidence parameter in (10a) is determined by the relative magnitudes of the supply and demand elasticities for X as follows (Chang and Kinnucan):

$$(10b)\quad \Omega = \dot{\eta}/(\dot{\varepsilon} + \dot{\eta})$$

where ° and ¥ are "total" elasticities whose values depend on trade status Specifically, if trade status is net exporter ($X_T > 0$), then

$$\dot{\varepsilon} = \epsilon_f$$

and

$$\dot{\eta} = (X_D/X_S)\,\lambda - (X_T/X_S)\,e_D.$$

Alternatively, if trade status is net importer ($X_T < 0$), then;

$$\dot{\varepsilon} = (X_S/X_D)\,\epsilon_f - (X_T/X_D)\,e_S$$

and

$$\dot{\eta} = \lambda = S_f\,\eta + S_m\,\sigma.$$

Note that trade status has consequences for incidence and hence advertising profitability In particular, with the maintained hypothesis that $\in_f = 0$, producers bear the full incidence ($\Omega = 1$) when trade status is net exporter, as the total supply elasticity for X is zero. Conversely, when trade status is net importer, foreign supplies of X are available to the industry, which means that X's supply elasticity in general is positive and some of the advertising cost is shifted to consumer ($0<\Omega<1$) Thus, a net importer trade status yields larger advertising rents, *ceteris paribus*, than a net exporter trade status

Equations (10a) and (10b) constitute a generalization of Nerlove and Waugh's theory of cooperative (generic) advertising in that they take into account tax shifting and cost sharing, the marketing channel, imperfect competition, and trade. Importantly, Nerlove and Waugh's model is seen as applying strictly to a closed-economy situation.

### 3.2 Small, Open-Economy Problem

A small, open-economy (SOE) problem arises when trade barriers are low or absent and the crop represented by the promotion entity is too small in relation to the total volume traded to affect price (e.g., Alston, Carman and Chalfant). Since price-enhancement is necessary for advertising to be profitable (see (9')), generic advertising under SOE conditions is problematic.

The reason that generic advertising is problematic under SOE conditions is that the excess demand curve in the net exporter case and the import supply curve in the net importer case is horizontal. In either case, the absolute value of the trade elasticity is infinity and (10a) reduces to

(11) $dR/dA = -\Omega\phi$,

which means that the industry suffers a marginal loss equal to incidence (adjusted for any cost sharing associated with advertising import levies or subsidies). Note from (11) that the marginal loss is invariant to $\beta$, i.e., the magnitude of the demand shift caused by the advertising. Thus, a positive (and statistically significant) ∃ is a necessary but not sufficient condition for advertising to be profitable (Piggott, Piggott, and Wright).

### 3.3 Relationship Between Oligopoly Power and Marginal Returns

Of particular interest in this paper is whether downstream oligopoly power enhances or diminishes advertising rents at the farm level. This can be determined by taking the partial derivative of (10a) with respect $\theta$, which yields

(12) $\partial MRR/\partial\theta = \Psi^{-1}\beta[2\, S_f(\eta - \theta) + S_m\, \Phi\, (1 - \eta + 2\theta) + \eta\, k\, e] / (\eta D^2)$

where $D = [\omega_f (0 - 2) + T_m\, \Phi\, (1 + 2) - k\, e\, (1 + 2)]$. Since the denominator of (12) is positive, the sign of (12) depends on the sign of its numerator, which in general is indeterminate. However, insight into the relationship can be obtained by considering two limiting cases.

The first limiting case is when marketing technology is fixed proportions ($\sigma = 0$). In this case, with the maintained hypothesis that $(\eta-\theta) > 0$, (12) is always positive in sign. That is, an increase in oligopoly power causes farm-level returns to generic advertising to increase. The intuition for this result is that fixed proportions strengthens market power by causing demand at the farm level to become less elastic. Although marketing technology in general is not expected to be fixed proportions (Wohlgenant, 1993), it may be a plausible assumption in short-run situations where substitution possibilities are limited due to asset fixity, credit rationing, or other factors.

The second limiting case is autarky ($k = 0$). In this case, and with the maintained hypothesis that marketing technology is variable proportions ($\sigma > 0$), (12) indicates an unambiguous positive relationship between oligopoly power and advertising so long as retail demand is not "too elastic," i.e., $\eta<1+2\theta$. Because retail demand for most food products is price inelastic, the latter condition is quite general.[3] It is also consistent with Suzuki *et al*'s empirical findings for fluid milk advertising in which oligopoly power increased farm-level returns. In that study, $k = 0$, $\eta = 0.687$, and $0.09 \le \theta \le 0.16$ (Suzuki *et al*, pp 300-301). Thus, under autarky conditions oligopoly power in general is expected to be rent-increasing.

The third limiting case is the SOE situation, in which case, by L'Hôpital's rule, (12) reduces to

$$\partial MRR/\partial\theta\,\big|_{e\to\infty} = -1/(1+\theta),$$

which is always negative in sign. That is, an increase in oligopoly power always increase the returns to promotion in a SOE situation. Combining the three cases, upstream oligopoly power has the potential to enhance upstream returns to promotion provided marketing technology is fixed proportions, retail demand is inelastic, or trade exposure is modest (What constitutes "modest" will become apparent in the simulations later )

### 3.4 Optimal Advertising Expenditure

The optimal expenditure for generic advertising occurs where the marginal net return is zero, i e , $dR/dA = 0$ in equation (10a) However, as pointed out by Nerlove and Waugh, an optimum expenditure level computed in this manner is likely to overstate the true optimum in that it ignores opportunity cost Opportunity cost of advertising can be incorporated into the analysis by defining a parameter ρ that represents the marginal rate of return on the next-best use of advertising funds (e g , production research, see Wohlgenant, 1993) In this case, returns to promotion are maximized when

$$dR/dA = \rho$$

Substituting (10a) into this expression and solving for $A$ (recalling that $\Psi = A/(P_f X_S)$) yields

$$(13)\quad A^* = P_f X_S \beta / [(\omega_f (\eta - \theta) + \omega_m \sigma (1 + \theta) - k\, e\, (1 + \theta))(\Omega\phi + \rho)]$$

where $A^*$ represents the advertising expenditure that maximizes net producer surplus Optimal expenditure varies directly with the factors that increase advertising's rent-enhancement ability (e g , less elastic supply or demand --see below) and that lower the effective cost of the advertising to X-producers (lower opportunity cost, levy share, or incidence)

## 4. Simulation

Additional insight into the determinants of generic advertising effectiveness can be obtained by equations (10a) and (10b) for alternative parameter values as indicated in Table 3. (P 270) For this purpose, we set the advertising elasticity and the advertising intensity parameter each to 0 02, which is equivalent to assuming that spending 2% of farm revenue on advertising will cause a 2% *horizontal* shift in the retail demand curve The median advertising intensity for 34 California crops with promotion programs (the only data available) is 1 7% (Alston, Carman, and Chalfant, p 161) Advertising elasticity estimates of 0 02 are not uncommon in the literature (Ferrero *et al* ) Thus, this assumption appears plausible, at least as a first approximation

The farmers' revenue share ($S_f$) is fixed at 0 50 in all the simulations so that attention can be focused on the effects of trade share and key elasticity values Trade share and elasticity values were selected based on Table 2 (P 269) and our assessment of plausible ranges For example, retail demand and substitution elasticities for most food items tend to be less than 1 in an affluent society with modern food processing/marketing technologies (Wohlgenant, 1989) Conjectural variation elasticities tend to be less than 0 4 (e g , Liu, Sun and Kaiser; Suzuki *et al* ) Because import supply and export demand are price elastic when small-country effects are at work, we set the trade elasticities to 2 and 4 in absolute value, values that appear to be appropriate for short-run simulations (Kinnucan 1997a)

The simulations are to be interpreted as indicating short-run returns, as (10a) was derived under the assumption that $\in_f = 0$ Since opportunity cost is an important element of advertising benefit-cost analysis (e g , Kinnucan and Christian), marginal returns are divided by 0 6, the rate of return that might be expected from investing advertising dollars in production research, the presumed next-best alternative An opportunity cost of 0 6 appears to represent an upper bound on private marginal returns to crop research in the

United States (Huffman and Evanson) As such, the Benefit-Cost ratios reported in Table 3 (P 270) provide a conservative measure of advertising profitability In this study, B-C ratios in excess of one are interpreted as indicating a profitable return, net of opportunity cost

Results highlight the importance of trade status as a determinant of generic advertising effectiveness (Table 3, P270). In particular, when trade status is net importer, B-C ratios are larger and exceed one more frequently (75%) than when trade status is net exporter (39%) B-C ratios are uniformly positive when trade status is net importer, but turn negative when trade status is net exporter and trade share and trade elasticity are relatively large ($k$ = 0 2, $e$ = - 4) Thus, it would appear that trade status is a key factor in identifying profitable promotion opportunities, at least in short-run situations where industry can benefit from cost shifting (compare incidences in Table 3 (P 270) for net importer ($k < 0$ ) and net exporter ($k > 0$) cases)

The second generalization from Table 3 (P.270) is that substitution effects are important In particular, commodities that have fewer substitutes at retail (less elastic retail demand) or that are not easily substituted away from at the middleman level (smaller substitution elasticity) will be more profitable to promote, *ceteris paribus*, than products that have many substitutes, or a close substitute, at retail or wholesale For example, increasing the retail demand elasticity from 0 5 to 1.0 cuts the marginal return by over one half (compare simulations 1 and 2) A similar effect is observed when the substitution elasticity is increased from zero to 0 5

A third generalization from Table 3 (P.270) is that trade erodes the rent-enhancing ability of oligopoly power This is most evident in simulations 3 and 4 in which an isolated increase in the import share from -0.1 to -0.2 causes the relationship between oligopoly power and rent to switch from positive to slightly negative under fixed proportions ($\sigma$ = 0) A similar weakening of the oligopoly power-rent relationship is observed when the trade elasticity is increased (compare simulations 2 and 3 and 6 and 7) Overall, generic advertising is most profitable for producers when substitution effects are weak, trade exposure is modest, trade status is net importer, and oligopoly power is high

## 5. Concluding Comments

A basic theme of this article is that competitive conditions in the marketing channel and trade exposure have an important bearing on farm-level returns to generic advertising Trade exposure is particularly germane in a small-country setting like Taiwan in that import supply or export demand for the advertised commodity is apt to be highly elastic, which undermines the ability of advertising to enhance price Without price enhancement, producer returns to generic advertising are nil

Because many of the commodities listed in Table 2 (P 269) have large trade shares, and the simulations in Table 3 (P 270) indicate that returns (net of opportunity cost) are problematic for trade shares as small as 20%, policy makers and producers in Taiwan are constrained in their choice of commodities to promote. In particular, using a cut-off trade share of 10%, and ignoring other factors that may affect producer returns (e g , policy setting), the most viable candidates for promotion are rice, poultry, eggs, vegetables and fruits [4] The fruit and vegetable categories contain many types and varieties, and care would have to be taken not to promote one at the expense of another (Kinnucan, 1996) If producers are required to pay for the advertising through an excise tax, fruits and eggs offer the most potential for rent enhancement, *ceteris paribus*, as their trade status is net importer, meaning that a portion of the advertising cost will be shifted to consumers.

As for imperfect competition, the effect of oligopoly power on advertising rents in general is *a priori* indeterminate However, if trade exposure is modest, retail demand is price inelastic, or marketing technology is fixed proportions, advertising rents are enhanced by oligopoly power In these circumstances, which may apply to poultry, and eggs, cooperatives or other institutional arrangements that confer oligopoly power will complement the generic advertising effort from the producer perspective

A caveat in interpreting our results is that they rely on average trade shares for the year In instances where production is seasonal and imports are used primarily to cover seasonal deficits (e g , fluid milk), there may be potential for advertising to benefit producers provided it is timed to coincide with the deficit periods (Kinnucan and Forker) In this case, whether promotion pays will depend on consumer responsiveness to the "pulsing" stategy, and on certain policy parameters such as the Class 1-Class 2 price differential Then, too, we have not examined the broader social welfare implications of generic advertising in terms of its impact on health, nutrition, and economic efficiency Clearly, advertising commodities linked to heart disease (e g , red meats), or advertising protected commodities (e g , rice, milk), may generate negative externalities that would have to be weighed against the internal benefits to the industry in question From this broader perspective, and bearing in mind the economic determinants discussed earlier, it would appear that the most viable candidates for government-sanctioned generic advertising in Taiwan are fruits and vegetables

## Footnotes

[1] Unfortunately, data are insufficient to provide a more detailed description of generic advertising in Taiwan However, we were able to determine that about one-third of government expenditures in agricultural marketing units in 1995-96 was devoted to fruit advertising The monies are consigned to farmers' organizations, industry associations, or private advertising cooperatives under the government's supervision or direction

[2] This assumption is in keeping with Nerlove and Waugh's model For models that relax this assumption, see Wohlgenant (1993), Piggott, Piggott and Wright, and Kinnucan (1997b)

[3] Technically, the requirement that $\eta < 1 + 2\theta$ for oligopoly power to increase advertising rents is overly restrictive For (12) to be positive, it is only necessary that $2\ S_f\,(\eta-\theta) > |S_m\sigma\,(1 - \eta + 2\theta)|$, which could happen with $\eta > 1 + 2\theta$ However, this simply strengthens the argument that oligopoly power is rent-increasing under autarky

[4] As pointed out by a reviewer, rice in Taiwan is protected by a price-support scheme and poultry and eggs are produced by commercial farms If the goal is to increase returns to individual farmers, then poultry and eggs could be excluded from the choice set Similarly, rice could be excluded, unless the level of protection is sufficiently low for advertising to push the market price above the support price or the goal of promotion is to lower taxpayer costs of the price-support program

## Appendix: Derivation of Reduced Form

Text equation (10a) was derived from text equations (1') - (9') in seven steps using Cramer's rule

Step1 Solve for equilibrium in the *Q*-product market (insert (1') into (2') and put the exogenous variable ($A^*$) on the right-hand side)

(A.1) $(\eta-\theta)\,\omega_f P_f^* + (\eta-\theta)\,\omega_m P_m^* + (1+\theta)\,Q^* = \beta A^*$

<u>Step 2</u> Solve for equilibrium in the $M$-factor market (set (4') = (6') and put all endogenous variables on left-hand-side)

(A.2) $\omega_f \sigma P_f^* - (\omega_f \sigma + \in_m) P_m^* + Q^* = 0$

<u>Step 3</u>: Solve for equilibrium in the $X$-factor market

<u>Step 3a</u> Substitute (5') and (7') into (8') and solve for $X_D^*$

(8'') $X_D^* = [(1+k)\in_f - k\,e]\,P_f^*$

where $k = (X_T/X_D)$ is the trade share

<u>Step 3b</u> Set (8'') = (3') and put all endogenous variables on left-hand-side

(A 3) $[(1+k)\in_f - k\,e + \omega_m \sigma]\,P_f^* - \omega_m \sigma P_m^* - Q^* = 0$

<u>Step 4</u> Write (A 1) - (A 3) in matrix form

$$\begin{bmatrix} (\eta-\theta)\omega_f & (\eta-\theta)\omega_m & (1+\theta) \\ \omega_f\sigma & -(\omega_f\sigma+\in_m) & 1 \\ \begin{bmatrix}(1+k)\in_f \\ -ke+\omega_m\sigma\end{bmatrix} & -\omega_m\sigma & -1 \end{bmatrix} \begin{bmatrix} P_f^* \\ P_m^* \\ Q^* \end{bmatrix} = \begin{bmatrix} \beta A^* \\ 0 \\ 0 \end{bmatrix}$$

<u>Step 5</u> Solve for Jacobian

$$|J| = \begin{bmatrix} (\eta-\theta)\omega_f & (\eta-\theta)\omega_m & (1+\theta) \\ \omega_f\sigma & -(\omega_f\sigma+\in_m) & 1 \\ [(1+k)\in_f - ke+\omega_m\sigma] & -\omega_m\sigma & -1 \end{bmatrix}$$

$$\begin{aligned} |J| = \; & (\eta-\theta)\omega_f\,[(\omega_f\sigma+\in_m)+\omega_m\sigma] \\ & - \omega_f\sigma\,[-(\eta-\theta)\omega_m + \omega_m\sigma(1+\theta)] \\ & + [(1+k)\in_f - k\,e + \omega_m\sigma]\,[(\eta-\theta)\omega_m \\ & + (\omega_f\sigma+\in_m)(1+\theta)] \end{aligned}$$

Setting $\in_f = 0$, and expanding and collecting terms, yields

(A 4) $$\begin{aligned} |J|_{\in_f=0} = \; & \sigma\,[(\eta-\theta)(\omega_f+\omega_m)^2 \\ & - \omega_f(1+\theta)\,k\,e] + \in_m[\omega_f(\eta-\theta) \\ & + \omega_m\sigma(1+\theta) - k\,e\,(1+\theta)] \\ & - \omega_m\,k\,e\,(\eta-\theta) \end{aligned}$$

<u>Step 6</u> Solve for $P_f^*$ using Cramer's rule, which states:

(A 5) $p_f^* = |J_p| \,/\, |J|_{\in_f=0}$

where

$$|J_p| = \begin{bmatrix} \beta A^* & (\eta-\theta)\omega_m & (1+\theta) \\ 0 & -(\omega_f\sigma+\in_m) & 1 \\ 0 & -\omega_m\sigma & -1 \end{bmatrix}$$

Performing the indicated mathematical operations gives

$$\begin{aligned} |J_p| &= [(\omega_f+\omega_m)\Phi + \in_m](\beta A^*) \\ &= [((\eta-\theta)/\eta)(S_f+S_m)\sigma + \in_m](\beta A^*) \end{aligned}$$

(A 6) $$= \{[(\eta-\theta)\sigma + \in_m \eta\,](\beta/\eta)\}\,A^*$$

Substituting (A 6) and (A 4) into (A 5), and taking the limit as $\in_m \to \infty$, using L'Hôpital's rule, yields

(A 7) $$\begin{aligned} P_f^*|_{\in_f=0,\,\in_m\to\infty} = \; & [\beta/(\omega_f(\eta-\theta) \\ & + \omega_m\sigma(1+\theta) - k\,e\,(1+\theta)]\,A^* \end{aligned}$$

<u>Step 7</u> Dividing (9') through by $dA$ yields

(9'') $dR/dA = \Psi^{-1}(P_f^*/A^*) - \Omega\phi$

Substituting (A 7) into (9'') gives text equation (10a)

(A 8) $$dR/dA = \Psi^{-1}\beta\,/\,[\omega_f((\eta-\theta) + \omega_m\sigma(1+\theta) - k\,e\,(1+\theta)] - \Omega\phi$$ QED

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**Table 1. Real Government Budgets in Agricultural Marketing Unites for Agricultural Products' Generic Promotion (million 1991 NT$), Taiwan, 1992-96**

| Year | Councıl of Agrıculture Executıve Yuan | Department of Agrıculture and Forestry, Taıwan Provıncıal Government | Total |
|---|---|---|---|
| 1992 | 4.31 | 2.93 | 7 24 |
| 1993 | 9 89 | 2.83 | 12 72 |
| 1994 | 9.15 | 3 29 | 12 44 |
| 1995 | 22.85 | 5 25 | 28.10 |
| 1996 | 20.91 | 7 68 | 28.59 |
| Ratıo 1996/1992 | 4 85 | 2.72 | 3 95 |

**Source: COA, Agricultural Marketing Services, Department of Farmers' Service. The CPI (1991 = 100) used to deflate the budget numbers was obtained from Executive Yuan, Directorate - General of Budget, *Commodıty-Prıce Statistics Monthly in Taıwan Area of the Republıc of China.***

**Table 2. Trade Status of Selected Agricultural Commodities, Taiwan, 1993-95 Annual Average**

| Commodity | Domestic Production ($X_S$) | Domestic Consumption ($X_D$) | Net Trade ($X_T$)[a] | Trade Share ($X_T/X_D$) |
|---|---|---|---|---|
| | ---------------1000 metric tons --------------- | | | |
| Pork | 1245 | 995 | 251 | 0.250 |
| Rice | 1728 | 1562 | 166 | 0.106 |
| Poultry | 630 | 623 | 7 | 0.012 |
| Eggs | 323 | 324 | -1 | -0.003 |
| Fish | 1348 | 1035 | 313 | 0.302 |
| Vegetables | 2296 | 2291 | 5 | 0.002 |
| Potatoes | 36 | 234 | -198 | -0.848 |
| Fruits | 3039 | 3336 | -297 | -0.089 |
| Cassava | 2 | 1127 | -1125 | -0.998 |
| Sugars | 454 | 747 | -293 | -0.392 |
| Beef | 5 | 64 | -58 | -0.915 |
| Milk | 315 | 455 | -140 | -0.307 |
| Corn | 393 | 6284 | -5891 | -0.937 |
| Soybeans | 11 | 2494 | -2483 | -0.996 |
| Wheat | 5 | 983 | -979 | -0.995 |
| Sorghum | 105 | 212 | -107 | -0.506 |

[a] Negative sign means net imports

**Source: Executive Yuan, Council of Agriculture, *Taiwan Food Balance Sheet*, various issues, 1993-96**

**Table 3. Effects of Oligopoly Power (2), Trade Share (*k*), Trade Elasticity (*e*), Retail Demand Elasticity (0), Substitution Elasticity(F), and Incidence (S) on Marginal Returns to Generic Advertising [a]**

| *k* | *e* | η | σ | θ | Ω [b] | d*R*/d*A* | B-C Ratio [c] |
|---|---|---|---|---|---|---|---|
| ***Simulation 1.*** | | | | | | | |
| -0 1 | 2 | 0 5 | 0 | 0 | 0 56 | 1 67 | 2 78 |
| -0 1 | 2 | 0 5 | 0 | 0 2 | 0 56 | 2 47 | 4 12 |
| -0 1 | 2 | 0 5 | 0 | 0 4 | 0 56 | 2 89 | 4 82 |
| -0 1 | 2 | 0 5 | 0 5 | 0 | 0 71 | 0 71 | 1 19 |
| -0 1 | 2 | 0 5 | 0 5 | 0 2 | 0 71 | 1 25 | 2 08 |
| -0 1 | 2 | 0.5 | 0.5 | 0 4 | 0 71 | 2.06 | 3 44 |
| ***Simulation 2:*** | | | | | | | |
| -0 1 | 2 | 1 | 0 | 0 | 0 71 | 0 71 | 1.19 |
| -0 1 | 2 | 1 | 0 | 0 2 | 0 71 | 1 07 | 1.79 |
| -0 1 | 2 | 1 | 0 | 0.4 | 0 71 | 1 46 | 2 43 |
| -0 1 | 2 | 1 | 0 5 | 0 | 0 79 | 0 26 | 0 44 |
| -0 1 | 2 | 1 | 0 5 | 0 2 | 0 79 | 0 46 | 0 77 |
| -0 1 | 2 | 1 | 0 5 | 0 4 | 0 79 | 0 70 | 1 17 |
| ***Simulation 3.*** | | | | | | | |
| -0 1 | 4 | 0 5 | 0 | 0 | 0 38 | 1 15 | 1 92 |
| -0 1 | 4 | 0 5 | 0 | 0 2 | 0 38 | 1 37 | 2 28 |
| -0 1 | 4 | 0 5 | 0 | 0 4 | 0.38 | 1 37 | 2 28 |
| -0 1 | 4 | 0 5 | 0 5 | 0 | 0.56 | 0 56 | 0 93 |
| -0 1 | 4 | 0 5 | 0 5 | 0 2 | 0 56 | 0 78 | 1 30 |
| -0 1 | 4 | 0 5 | 0 5 | 0 4 | 0 56 | 1 01 | 1 68 |
| ***Simulation 4*** | | | | | | | |
| -0 2 | 4 | 0 5 | 0 | 0 | 0 24 | 0 71 | 1 19 |
| -0 2 | 4 | 0 5 | 0 | 0 2 | 0.24 | 0 71 | 1.19 |
| -0 2 | 4 | 0 5 | 0 | 0 4 | 0 24 | 0 65 | 1 08 |
| -0 2 | 4 | 0 5 | 0 5 | 0 | 0 38 | 0 38 | 0 64 |
| -0 2 | 4 | 0 5 | 0 5 | 0 2 | 0 38 | 0.43 | 0 71 |
| -0 2 | 4 | 0 5 | 0 5 | 0 4 | 0 38 | 0 45 | 0 75 |
| ***Simulation 5:*** | | | | | | | |
| 0 1 | -2 | 0 5 | 0 | 0 | 1 00 | 1 22 | 2 04 |
| 0 1 | -2 | 0 5 | 0 | 0 2 | 1 00 | 2.03 | 3 38 |
| 0 1 | -2 | 0.5 | 0 | 0.4 | 1 00 | 2 45 | 4 08 |
| 0 1 | -2 | 0 5 | 0 5 | 0 | 1 00 | 0 43 | 0 71 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 1 | -2 | 0 5 | 0 5 | 0 2 | 1 00 | 0 96 | 1 60 |
| 0 1 | -2 | 0 5 | 0 5 | 0 4 | 1 00 | 1 78 | 2 96 |
| ***Simulation 6:*** | | | | | | | |
| 0 2 | -2 | 0.5 | 0 | 0 | 1 00 | 0 54 | 0 90 |
| 0 2 | -2 | 0 5 | 0 | 0 2 | 1 00 | 0 75 | 1 26 |
| 0 2 | -2 | 0 5 | 0 | 0 4 | 1.00 | 0 75 | 1 26 |
| 0 2 | -2 | 0 5 | 0.5 | 0 | 1 00 | 0 11 | 0.19 |
| 0 2 | -2 | 0 5 | 0.5 | 0 2 | 1 00 | 0 33 | 0 56 |
| 0.2 | -2 | 0.5 | 0 5 | 0 4 | 1 00 | 0 56 | 0 94 |
| ***Simulation 7:*** | | | | | | | |
| 0 2 | -4 | 0 5 | 0 | 0 | 1 00 | -0 05 | -0 08 |
| 0 2 | -4 | 0 5 | 0 | 0 2 | 1 00 | -0 05 | -0 08 |
| 0.2 | -4 | 0 5 | 0 | 0 4 | 1 00 | -0 12 | -0 19 |
| 0 2 | -4 | 0 5 | 0 5 | 0 | 1 00 | -0 23 | -0 38 |
| 0 2 | -4 | 0 5 | 0 5 | 0 2 | 1 00 | -0 19 | -0 31 |
| 0 2 | -4 | 0 5 | 0 5 | 0 4 | 1 00 | -0 17 | -0 28 |

[a] Simulations are based on text equations (10a) and (10b) They assume that domestic farm production is fixed ($\in_f = 0$), the supply curve for marketing inputs is horizontal ($\in_m = \infty$), the farmers' revenue share is 0 5 ($S_f = 0$ 5), import levies and promotion subsidies are zero ($\phi = 1$ 0), advertising intensity is 0 02 ($\Psi = 0$ 02), and the advertising elasticity is 0 02 ($\beta = 0$ 02)

[b] Incidence is endogenous, dependent on $k$, $e$, $\eta$ and $\sigma$ (see text equation (10b))

[c] $dR/dA$ divided by $\rho = 0$ 6, where $\rho$ is the opportunity cost of advertising funds

# 不完全競爭市場與農產貿易兼顧之條下，農產品產業廣告有效性之決定因素研究

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## 摘要

本篇理論所導出之公式主要是用來顯示中間運銷廠商間之寡占程度、農產品進出口貿易程度、及由於農產品個別產業爲加強廣告促銷而徵收基金所導致農產品成本增加等因素，對廣告之邊際收益的影響。關於市場寡占程度對廣告獲利性之影響情形，則當產銷過程間投入因素之技術轉換係數是固定的、農產品零售階段是屬價格需求無彈性、及農產貿易表現度呈現中程度狀態時，提高中間運銷廠商間之市場寡占程度，可提昇產地階段之產業廣告邊際收益。另就農產貿易的情形而言，在其他條件不變之下，該研究之農產品，其於貿易淨進口的狀況下，比貿易淨出口的狀況更具獲利性。若將本文所研究出之理論及模擬方式運用至臺灣時，則蔬菜與水果可爲由因產業廣告投入而較具獲利性之兩項產品．

**關鍵詞：一般性整體廣告、不完全競爭、貿易貨物**