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Advertising Check-Off Programmes

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Abstract: This paper examines the impact of a change in the advertising tax on prices, output, and welfare. Results show that a supply shift alone (i.e., advertising is ineffective and hence there is no demand shift) will result in higher retail prices, lower farm output, higher retail-farm price ratios, and losses in benefits to society. If the supply shift is accompanied by a demand shift due to effective advertising, the retail price will be higher. Farm output and the retail-farm price ratio, however, will be smaller compared to an isolated supply shift. Given the advertising elasticities found so far in empirical studies (less than 0.10), an increase in producer assessments or check-offs for the purpose of increasing demand through advertising will lead to welfare loss. Research and new product development may be better alternatives to increasing demand from a social perspective.

Introduction

Commodity check-off programmes have been in existence in the USA since 1935 (the first was the Florida Citrus Advertising Act) and have proliferated over time. In 1989, there were 350 federal- and state-legislated promotional programmes that covered over 80 farm commodities and cost more than $530 million. Funding for these programmes comes primarily from mandated producer assessments and check-offs based on two types of legislation, research and promotion acts and marketing orders.

Under the check-off programmes, producers are required by statute to pay advertising excise taxes or assessments for each unit of output sold. The revenues are then used by commodity promotional organizations and marketing boards for market development and research (Armbruster and Frank, 1988). The dairy programme is by far the largest, with annual collection exceeding $200 million, followed by beef and pigmeat, which have annual collections exceeding $80 million and $26 million, respectively. The assessment rates are 15 cents per cwt for milk, $1.00 per head for beef, and 25 cents per $100 of pig value for pigmeat.

Model

Let us consider a competitive food marketing industry using two types of inputs, farm-based inputs, a, and marketing inputs, b, to produce a food product, x, sold in the retail market (Gardner, 1975). All firms are assumed to be price takers in both the product and factor markets.

The marketing industry's production function:

$$(1) \quad x = f(a, b)$$

is assumed to yield constant returns to scale. The demand function for x at the retail level is:

$$(2) \quad x = D(P_x, A)$$

where P_x is the retail price of x, and A is advertising for x.[2]

The model also includes four equations representing both the demand and supply for a and b. Assuming profit-maximizing behaviour, the demand for the farm-based input is:

$$(3) \quad P_a = P_x f_a$$

The demand for marketing inputs is:

$$(4) \quad P_b = P_x f_b$$

where f_a and f_b are the marginal product of a and b, respectively. Supply functions of farm-based and marketing inputs are represented, respectively, by:

(5) $P_a = h(a, T)$

(6) $P_b = g(b)$

where T is the advertising tax or the check-off amount.

When a specific (as opposed to *ad valorem*) advertising tax is imposed, the total tax revenue, TR, is Ta. TR may or may not equal A in Equation (2). This depends *inter alia* on how TR is allocated among market development activities and how advertising is measured. For example, A may be measured in dollars, advertising goodwill (Nerlove and Waugh, 1961), advertising effort (Zufryden, 1978), or gross rating points (Heath, 1990). In the simplified case, A represents the total tax collection, which is spent entirely on advertising; i.e., $A = TR$. More generally, A is a function of the tax rate and farm output:

(7) $A = k(T, a)$

Partial derivatives of A with respect to T and a, A_T and A_a, respectively, are assumed to be positive.

Equation (7) plays a significant role in the analysis. It links the supply shifter (tax rate) to the demand shifter (advertising) and makes it possible to analyse both shifts simultaneously with respect to just one exogenous variable, the tax rate.[3] The endogenous variables are x, a, b, P_x, P_a, and P_b. Changes in market equilibrium conditions are analysed by differentiating Equations (1)–(6) with respect to T.

This model differs from Gardner's in that, instead of considering an exogenous shift in demand or supply separately, it considers shifts in retail demand and farm supply simultaneously.[4] This is necessary because a change in the advertising tax rate affects not only the cost of production but also the budget constraint for advertising, which, in turn, affects the demand for an advertised product.

Total Elasticities

The principal objective here is to determine the effect of a change in the advertising excise tax on retail price, farm output, and the retail-farm price ratio. Following Gardner's derivation procedures, total elasticities for these three variables with respect to the tax rate are presented as E_{PxT}, E_{aT}, and $E_{Px/PaT}$ in Equations (8)–(10).

$$(8)\quad E_{PxT} = e_T e_a S_a(e_b+\sigma) + \frac{-\eta_A[(e_{Aa}e_T e_a - e_{AT})(S_a e_b+\sigma) - e_{AT}S_b e_a]}{D}$$

$$(9)\quad E_{aT} = e_T e_a[\eta\sigma + e_b(S_a\eta - S_b\sigma)] + \frac{\eta_A e_{AT} e_a(e_b+\sigma)}{D}$$

$$(10)\quad E_{Px/PaT} = e_T e_a S_b(\eta - e_b) + \frac{-\eta_A\{e_{Aa}e_T e_a(S_a e_b+\sigma) - e_{AT}[(S_b e_a + S_a e_b+\sigma) - e_a(e_b+\sigma)(\frac{1}{\eta_a})]\}}{D}$$

where $S_a = aP_a/xP_x$, the relative shares of a, σ = elasticity of substitution between a and b, η = retail demand elasticity of x, e_a = own-price elasticities of supply for a, e_b = own-price elasticities of supply for b, η_A = advertising elasticity of demand for x, e_T = elasticity of P_a with

respect to T, η_a = elasticity of derived demand for a, e_{AT} = elasticities of advertising with respect to T, and e_{Aa} = elasticities of advertising with respect to a.

The denominator of Equations (8)–(10) is:

$$(11)\quad D = -\eta(S_b e_a + S_a e_b + \sigma) + e_a e_b + \sigma(S_a e_a + S_b e_b) - \eta_A e_{Aa} e_a (e_b + \sigma)^5$$

The sign of D can be determined by rewriting Equation (11) as:

$$(12)\quad D = (1 - \eta_A e_{Aa}) e_a e_b + \sigma[S_a e_a + S_b e_b - (\eta_A e_{Aa} e_a + \eta)] - \eta(S_b e_a + S_a e_b)$$

D is positive if $\eta < 0$, $0 < \eta_A < 1$, $0 < e_{Aa} < 1$, and e_a, e_b, $e_T > 0$ and if $(\eta_A e_{Aa} e_a + \eta) < 0$. The latter is true if the advertising elasticity is small relative to demand elasticity in absolute value. This assumption is reasonable since most empirical advertising elasticities for food items are less than 0.10 (Hurst and Forker, 1989), whereas demand elasticities range from −0.14 to −2.63 (Brandow, 1961; and George and King, 1971).

Both the numerator and denominator in Equations (8)–(10) can be separated into two parts: the supply shift component (SSC) resulting from a change in the tax rate, and the demand shift component (DSC) resulting from a change in advertising. Note that e_T and η_A are the key parameters for the SSC and DSC, respectively.

Analysis

If demand and supply curves have normal slopes, the SSCs represented by the first terms in Equations (8) and (9) are expected to be positive and negative, respectively, because a parallel upward shift of the farm supply curve induced by a tax increase leads to higher prices and lower output. The DSCs represented by the second term are expected to be positive because an upward (not necessary parallel) shift of the retail demand curve leads to higher prices and output. In Equation (10), the SSC is expected to be negative and the DSC positive.

If advertising is ineffective (i.e., if $\eta_A = 0$), the second terms in Equations (8)–(11) vanish; therefore, only an isolated supply shift is present, as in Gardner (1975). As expected, an increase in advertising tax in this case will increase the retail price, decrease farm supply, and decrease the retail-farm price ratio. The economic logic behind these results is that, when farm supply shifts to the left, both retail and farm price will tend to increase, causing a decrease in the quantity demanded of x. The decrease in the quantity demanded for x releases marketing inputs. So long as $e_b > 0$, P_b will fall, which reduces the cost of marketing inputs relative to farm input and hence the ratio P_x/P_a.[6]

On the other hand, if a tax increase does not affect farm price (i.e., if $e_T = 0$), then SSC vanishes. This happens if farm demand is perfectly elastic; therefore, a supply shift does not affect farm price. An increase in advertising tax in this case will result in increases in retail price, farm supply, and the retail-farm price ratio.

When e_T and η_A are not both zero, the signs of Equations (8)–(10) cannot be determined *a priori*. Hypothetical parameter values can be used for illustrative purposes. Following Gardner, e_a, e_b, η, and S_a were set equal to 1.0, 2.0, −0.5, and 0.5, respectively; and σ, the elasticity of substitution between farm-based input and marketing inputs, is set alternately to 0 and 0.5. e_T is set alternately to 0, 0.5, and 1.0. The long-run advertising elasticities are set between 0 and 0.35. Parameters pertaining to advertising such as e_{Aa} and e_{AT} are set equal to 1.0.[7]

Simulated results show that total elasticities are sensitive to changes in the advertising elasticity, σ, and e_T (Table 1). For example, when the advertising elasticity becomes greater, the total elasticity of retail price continues to rise while the total elasticities of farm output and the retail-farm price ratio first decrease, reach zero, and then increase. The sign changes for the latter two imply an increase in the importance of the DSC relative to the SSC as advertising becomes more effective. On the other hand, the greater the σ, the less the retail

price, farm output, and the retail-farm price ratio will change as alternative input combinations exist. Further, all three elasticities increase with e_T in absolute terms, which means that the greater the impact of the tax on farm price, the greater the impact of the tax at all levels of the market.

Table 1—Economic Effects on Prices and Output of a 10-Percent Increase in the Advertising Tax

e_T	η_A	Retail Price Elasticity		Farm Output Elasticity		Price Ratio Elasticity	
		σ		σ		σ	
		0.0	0.5	0.0	0.5	0.0	0.5
0.50	0.00	1.82	1.67	−0.91	−1.33	−2.27	−1.67
0.50	0.05	2.08	1.90	−0.57	−1.00	−0.47	−0.86
0.50	0.07**	2.18	1.99	−0.42	−0.86	0.29	−0.52
0.50	0.09	2.30	2.09	−0.27	−0.72	1.07	−0.18
0.50	0.11**	2.41	2.19	−0.12	−0.57	1.88	0.18
0.50	0.13*	2.53	2.30	0.04	−0.42	2.71	0.55
0.50	0.17	2.78	2.52	0.37	−0.10	4.46	1.32
0.50	0.19*	2.91	2.63	0.55	0.07	5.38	1.72
1.00	0.00	3.64	3.33	−1.82	−2.67	−4.55	−3.33
1.00	0.13	4.28	3.84	−0.96	−1.78	−0.06	−1.56
1.00	0.14**	4.33	3.88	−0.89	−1.71	0.32	−1.41
1.00	0.22	4.81	4.25	−0.26	−1.06	3.64	−0.13
1.00	0.23**	4.87	4.30	−0.17	−0.98	4.08	0.05
1.00	0.24	4.93	4.35	−0.09	−0.89	4.54	0.22
1.00	0.25*	5.00	4.40	0.00	−0.80	5.00	0.40
1.00	0.33	5.57	4.84	0.77	−0.03	9.02	1.93
1.00	0.34*	5.65	4.90	0.87	0.07	9.57	2.14

e_T = elasticity of farm price with respect to advertising tax. η_A = advertising elasticity. σ = elasticity of substitution between farm-based input and marketing inputs. *Indicates the break-even points for farm output. **Indicates the break-even points for the retail-farm price ratio.

For illustrative purposes, let us consider the case in which e_T = 1.0 (the bottom half of Table 1). For σ = 0, the break-even point for farm output (E_{aT} = 0) occurs when the advertising elasticity is 0.25 (see Table 1, col. 5). This means that the leftward supply shift caused by an increase in advertising tax is compensated exactly by the demand shift due to advertising, leaving farm output unchanged. When the advertising elasticity is greater than 0.25, farm output exceeds the pre-tax level.

The break-even point for the retail-price ratio ($E_{Px/PaT}$ = 0) occurs when the advertising elasticity is about 0.14 and becomes positive thereafter (see Table 1, col. 7).

When σ = 0.5, the break-even points, identified by the advertising elasticity, for E_{aT} and $E_{Px/PaT}$ increase to 0.34 and 0.23, respectively. This means that if substitution possibilities exist between farm-base input and marketing input, more effective advertising is required to compensate for the reduced demand for the farm-based input due both to higher prices and the substitution effect.

Because E_{PxT} is positive throughout, an advertising tax increase always leads to higher retail prices. Therefore, in the case where the demand curve shifts in a parallel manner, there will be a loss in total social welfare if advertising does not shift demand sufficiently to restore farm output to the pre-tax level.[8]

Because advertising effectiveness (as measured by the magnitude of the advertising elasticity) plays a pivotal role in determining the economic impacts of check-off programmes, it is in the public interest that funds be allocated to ensure the maximum possible impact of the advertising investment. If advertising is not successful at bringing about a sufficiently large shift in the demand curve, alternatives such as research, nutrition education, or new product development may deserve greater attention.

Concluding Remarks

Partial-equilibrium analysis of commodity check-off programmes suggests that advertising-induced demand shifts will have to be large for the programmes to compensate for the decrease in farm output due to advertising taxes.

A caveat in interpreting these conclusions is that the analysis is static and implicitly assumes perfect knowledge on the part of consumers. In a dynamic setting, the information conveyed in advertising can reduce time lags in adjusting to new equilibria and enhance competition. If the advertising results in more accurate knowledge of product characteristics, additional welfare benefits accrue to consumers. Finally, if advertising is subject to financial external economies of scale, the enhanced demand for advertising services occasioned by the recent introduction of large mandatory check-off programmes could result in economy-wide reductions in marketing cost, a welfare benefit not considered by the partial-equilibrium approach adopted in this study. As suggested by the analysis, commodity advertising taxes in general can be expected to result in higher retail prices for food and a reduction in farm output.

Notes

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[2]Although cross-commodity advertising may exist, its impact, like other demand shifters, is assumed to be constant and hence does not appear in Equation (2). Alternatively, A can be thought of as net advertising for x, net of cross-commodity advertising. The second interpretation implies that the net advertising elasticity for the commodity under consideration may be smaller than the gross measure that ignores competitive advertising.

[3]The tax rate and advertising are assumed to be exogenous because the former is set, in general, by the government through referenda, and decisions about advertising expenditures usually precede price determination.

[4]Time lags may exist between the demand shift and the supply shift since producers and consumers may not respond to policy change instantaneously. This analysis, however, is restricted to a long-run equilibrium and comparative statics framework; therefore, full adjustment to a change in exogenous variables from one equilibrium to another is implied. Total elasticities derived later are subject to the same interpretation.

[5]Derivations of Equations (8)–(11) are available from the authors on request.

[6]For further discussion, see Gardner, 1975.

[7]e_{AT} and e_{Aa} will equal 1 if advertising is defined as $A = Ta$.

[8]Possible distributional impacts on infra-marginal consumers and producers are not considered. Moreover, this measure does not take into account the value of information and the reduced cost of entertainment to consumers due to advertising (Ekelund and Saurman, 1988; and Doyle, 1968). In the case where demand shift is not parallel, the change in welfare depends on how demand is shifted.

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Discussion Opening—*Walter Armbruster* (Farm Foundation)

Chang and Kinnucan have admirably addressed a topic of increasing importance as more agricultural commodity producers seek to increase their income by product promotion. The attempts to expand demand by US producers are principally through advertising in domestic markets, although there is also some use of other market-expanding approaches, particularly in export markets.

This analysis of the effects of generic advertising programmes on various market levels provides some interesting insights. The authors' analytical model allows them to link the excise tax rate of the assessment with the advertising impact. If advertising is ineffective, the tax increases retail prices, decreases farm supply, and decreases the retail-farm price ratio.

The authors' simulated results indicate that the break-even point for farm output occurs when advertising elasticity is 0.25. Thus, economically rational producers must achieve an effective advertising elasticity of 0.25 if their goal is to increase their revenues. Since the authors report that most studies have found advertising elasticities of less than 0.10, this implies a loss in producer revenue.

If producers have estimates of effectiveness, will they abolish an ineffective programme relatively quickly? Do producers optimistically attribute all sales increases to advertising? Are producers obtaining adequate analyses of the responses to advertising expenditures to make rational decisions about continuing the programmes?

Chang and Kinnucan then turn to analysis of the policy implications reflected in welfare impacts from changes in the tax rate. What the authors conclude is that most increases in

producer assessments for advertising will lead to welfare losses. Is this true for all levels of advertising? Does it imply no social welfare gain from any generic advertising programme? Or, is there a minimum or threshold amount of advertising above which the welfare losses start?

The authors indicate that welfare transfers take place among consumers as well as among producers and thus exclude marginal producers and consumers from the market. We need to ask whether agricultural economists have paid enough attention to analysing the impacts of such welfare transfers.

The authors conclude that if advertising cannot be proved successful in shifting demand, producers and society in general may be better served by the use of assessments to fund research, nutrition education, and new product development.

Identifying the advertising elasticities and then educating producers, organizational leaders, and policy officials about their implications is a major challenge. We also need to ask if agricultural economists can also offer help to producers in assessing potential effectiveness of research, education, and new product development in expanding demand as alternatives to advertising.

General Discussion—*Chaur Shyan Lee, Rapporteur* (National Chung-Hsing University)

On the Shui *et al.* paper, the authors were asked whether, if US producers lose from OECD trade liberalization, cotton suppliers elsewhere gain. The OECD accounts for a relatively small share of US cotton exports; e.g., about 60 percent of US cotton goes to the Pacific Rim. Why was OECD trade included? Were substitution possibilities with synthetic fibres considered in the model? Parameters of the model were both estimated and borrowed from the literature under a régime without liberalization. These parameters are then used to evaluate the effects of a policy régime that includes trade liberalization. To what extent is the Lucas critique a problem in this study?

The authors replied that the foreign cotton producers gain. Multilateral liberalization is a more reasonable assumption (all the OECD countries liberalize). The important effect comes from the USA liberalizing its textile trade and non-OECD countries expanding their textile output and demand for cotton. The paper assumes horizontal supply of manufactured fibre, so there is no substitution.

On the Sparks and Bravo-Ureta paper, the authors were asked about the theoretical and empirical justification for choosing the inverse Rotterdam demand function instead of Armington or other models, why they used total import quantity instead of income in each import demand equation, and why they did not conduct tests of theory, linear homogeneity, weak separability, etc.

The authors replied that the inverse Rotterdam demand function is ideally suited to the problems facing US apple growers, where prices are decreasing while supplies increasing. The model is also quite tractable and implementable. In contrast, the Armington model is quite cumbersome and difficult to implement. They used total quantities instead of income because the question to be answered is concerned with quantities, not income. Also, the model construction is usually done with aggregated quantities, not income, for the inverse Rotterdam model. They will be conducting tests of the theoretical restrictions as they proceed with this work. Alternative models should be estimated to evaluate which specification is more consistent with the data, statistically speaking. This applies both to the functional form and to whether the model should be price or quantity dependent.

Participants in the general discussion included D.B. Han (Korea Rural Economics Institute).