

THE INCIDENCE OF THE COSTS AND BENEFITS OF GENERIC ADVERTISING

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Generic advertising is important and controversial. In 1990, commodity organizations in the United States spent over \$300 million on advertising (Lenz, Forker, and Hurst). The controversy over generic advertising is reflected in recent court cases, such as the 1996 Wileman case heard before the U.S. Supreme Court. Controversy over generic advertising also exists within the agricultural economics profession. A wide range of results can be found in past studies, partly because of different data sets and commodities, but also because of particular modeling choices. In this paper, we discuss some issues in studies of the demand response to generic advertising that pertain to measuring the welfare consequences, particularly the distributional effects.

Both advertising and the check-offs used to finance it have distributional consequences. The distributional effects among participating producers are of interest, since not all producers are in favor of mandatory check-offs to finance advertising. There are also effects on the welfare of producers of other goods, middlemen, suppliers of farming inputs, and consumers, not just the producers of the commodity being advertised. Since such schemes are authorized by government and use taxing powers (and exemptions from anti-trust rules), generic advertising funded by check-offs ought to be evaluated taking account of all affected individuals, and not just private benefits to participating producers.

Our comments in this paper are based on several studies in which we have developed a framework for measuring these distributional effects of generic advertising. The most challenging aspect has been the consumer welfare side. We begin with some general comments about issues related to the measurement of

the effects of generic advertising on demand. Next we discuss some specific issues that pertain to the measurement of the welfare consequences. Finally, we present empirical evidence concerning the effects on the welfare of producers and consumers of beef, pork, and poultry (chicken and turkey) arising from the generic advertising of beef and pork in the United States.

General Issues in Measuring the Effects of Advertising on Demand

When we include advertising variables in demand models and test their statistical significance, we effectively are testing a specific hypothesis regarding the presence of structural change in demand. The difficulty in testing for structural change with the typical time-series data on prices and expenditures is that a single data set must be used to estimate the nature of demands as well as their evolution over time. Past studies have shown that the results of tests for structural change depend on seemingly harmless choices made by the researcher, such as how to measure structural change or what functional form to specify for the demand equation.

Comparable considerations arise in evaluating advertising: the estimated effects of advertising will likely depend on many modeling decisions, such as the degree of aggregation over goods, the number of goods included, aggregation over time, functional form assumptions, and decisions concerning what is exogenous and what is endogenous. Furthermore, decisions must be made on how to measure advertising effort. Should some measure of the true quantity of advertising be used, such as gross ratings points, or is it sufficient to use expenditures on advertising? If the latter choice is made, should the expenditure variable be deflated by a measure of advertising costs, to produce a quantity index, or is it sufficient to deflate by the CPI? Finally,

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what expenditures should be included in the advertising variable that influences demand? Should it be only the variable costs of running an advertisement, or should the fixed costs of producing them be included as well, and, if so, how? Examples and some discussion of all of these choices can be found in the literature, but it is reasonable to expect the results to depend on which options are chosen, and there has been less discussion of that aspect.

Moreover, choices about advertising variables affect more than just the estimated advertising elasticity. For instance, suppose nominal advertising expenditures, income, and prices all are deflated by a price index such as the CPI, to ensure that only real variables appear as explanatory variables in a demand equation. The resulting specification is homogeneous with respect to the monetary variables, but not in a way that permits easy interpretation. The relationship among elasticities that normally holds, where the sum of price elasticities and the income elasticity equals zero, is not imposed in such a specification; the advertising elasticity becomes part of the homogeneity restriction on elasticities (Alston, Chalfant, and Piggott 1999a).

Another modeling choice is whether to estimate a single demand equation or a system of demand equations for goods affected by advertising. A demand system has three advantages: statistical efficiency, measures of cross-advertising effects, and theoretical consistency. More efficient parameter estimates are obtained from systems estimators than single-equation approaches. However, one might prefer single-equation estimation if there is doubt about the correctness of the specification of each equation in the system. Also, statistical efficiency is desirable, but usually not the most important reason for estimating a demand system. A desire to model the effects of advertising on the demand for the advertised good *and* the demands for related goods is probably the main motivation. Even if we are directly interested only in the demand for one good, we might have to model the demands for related goods in order to be able to measure the full effects of advertising on the good in question, given general equilibrium-type feedback from price changes. Individual demands could be estimated one equation at a time, but it seems appropriate to impose restrictions on the effects of advertising across all of the demand equations, as can be done in a demand system. For instance, the

sum of advertising effects across equations in a share system should be zero, again offering increased efficiency. The final reason for estimating a system is that, when the appropriate restrictions are satisfied by the estimated parameters, the demand system can satisfy integrability; it seems appropriate, if welfare effects are to be calculated, to do so in a model that is consistent with consumer theory.

In many applications, it is difficult to decide which goods should be included. In studies of beef advertising or pork advertising, it is natural to model those two goods jointly, along with obviously related goods such as poultry. However, for some goods, it is not obvious what the closest substitutes might be, and the relevant substitutes might change with the season. The difficulties surrounding these choices seem more serious in the context of a systems approach, where we have to model the demands for any substitutes, explicitly.

Nevertheless, having to decide on the relevant related goods is a problem for single-equation models, as well, in choosing which prices to include as demand shifters, and choices made about how to include those shifters can have important implications. For instance, a common specification is to assume only one relevant substitute good (e.g., other beverages in a model of the demand for milk), to include the two prices as a ratio, and to deflate the income variable by the CPI, as in the equation below:

$$\ln q_M = \alpha + \beta \ln\left(\frac{P_M}{P_B}\right) + \gamma \ln\left(\frac{I}{\text{CPI}}\right).$$

This specification involves unintended and undesirable restrictions on the elasticities of demand. Such mistakes are made less often in studies using system approaches, where theory provides stronger guidance about specification.

Functional form differences can be handled by estimating more than one functional form, to see if the estimates of advertising effects on demand are sensitive to that choice. It is easier to conduct the search over models than to formalize the model selection process, especially when the functional forms tried are non-nested alternatives, but progress has been made with nesting models. Piggott introduced a new demand system, the Nested PIGLOG (NEP), that nests all of the demand systems of the price-independent, generalized logarithmic form, including several demand systems previously used to

model advertising, and some altogether new ones. Piggott's specification permits the use of standard hypothesis tests to choose among specifications. The Rotterdam model is the main alternative not included. Results from application of the NEP model suggest that many commonly used forms may be too restrictive.

A final specification issue concerns the choice between conditional and unconditional demands. It is common to use expenditure on a group of related goods (that are assumed to be weakly separable) as the income variable in a demand system. This means that elasticities are conditional on the group expenditure, rather than total income. Hence, the elasticities must be interpreted as conditional ones, and if advertising has any effect on the group expenditure itself, rather than just affecting allocation within the group, that effect is not detected in a conditional demand system. In addition, group expenditure may be an endogenous right-hand side variable. The alternative to estimating conditional demands seems to be to create an aggregate, all-other-goods variable, which makes the demand system unconditional and avoids simultaneity bias if total income can be treated as exogenous. What is unknown is whether the bias from aggregating dissimilar goods is transmitted to the other equations in the demand system, and what effect that may have on estimates of interest, such as the coefficients on advertising variables in the other equations. Such choices about separability versus aggregation are unavoidable, and they have theoretical and empirical implications for the interpretation of welfare measures, and the measures themselves.

In summary, there are many research decisions that affect the results of advertising studies, a state of affairs that characterizes most of what we do. Complicating the problem in measuring advertising effects is the fact that the effects we are trying to measure are themselves probably small relative to the effects of prices and other things that change demand. We do not think that this means that agricultural economists are wasting their time trying to measure advertising effects. Rather, more studies are needed that evaluate the consequences of decisions made by researchers for their measures of the effects of advertising on demand or welfare. For instance, we have observed smaller advertising elasticities in Rotterdam models

of meat demand than models such as the Almost Ideal demand system. Is this a consistent pattern and, if so, why? A better understanding of the effects of modeling choices is especially important in making use of our scarce data resource when the effects are not easy to measure.

Issues in Measuring Welfare Effects

The legal disputes over mandatory promotion programs for agricultural commodities concerned the total benefits and costs and their distribution among different producer groups *within* the industry. In the policy debates, no attention has been paid to the interests of consumers or general taxpayers, nor to the cross-commodity effects on producers, all of which can be affected by the collection of a check-off to finance advertising or by the advertising itself, or both. Hence, the public policy debate has been based on incomplete, partial welfare measures. We require more complete welfare measures, paying greater attention to the effects on groups other than those producers directly involved, and more disaggregated measures to show the incidence among groups. Models suitable for these purposes have been used widely for the analysis of the incidence of commodity price-supports or agricultural R&D, but not for advertising.

In order to show the incidence of advertising and check-offs among producers of a commodity at the same market level, and across commodities, we require a model that is disaggregated *horizontally* (e.g., Piggott, Piggott, and Wright). We require *vertically* disaggregated model to show the distributional consequences up and down the market chain across suppliers of inputs used by farmers, middlemen, and final consumers (e.g., Wohlgenant, Kinnucan). The measurement of consumer welfare has been the sticking point in the welfare economic analysis of advertising. Hence, we focus on that aspect.

Options for Incorporating Advertising in Demand Systems

In recent work (e.g., Alston, Chalfant, and Piggott 1999b) we have argued that an approach that captures both producer and consumer welfare consequences of advertising can be applied when consumer demand

equations are derived from an expenditure function. So far we have tried two alternative ways of incorporating advertising in the NEP model, with applications at different times using Australian and U.S. meat consumption data.

One approach is a *scaling* approach, in which advertising changes the *effective* quantities and prices of goods (e.g., Brester and Schroeder). When using the scaling approach, a distinction is made between actual prices and quantities, and effective prices and quantities (denoted \tilde{p}_i and \tilde{q}_i). The relationship between actual and effective prices and quantities is of the form $\tilde{p}_i = p_i \phi(A_k)$ and $\tilde{q}_i = q_i / \phi(A_k)$ so that $\tilde{p}_i \tilde{q}_i = p_i q_i$. The function $\phi(A_k)$ rescales prices and quantities while holding actual and effective expenditures constant. In this approach, advertising is viewed as having the effect of causing the effective quantities and prices to change. The main alternative has been used in many studies: a varying-parameter specification, a *translating* approach (e.g., Pollak and Wales), in which the coefficients of a static demand model are themselves functions of advertising (e.g., Goddard and Amuah, Piggott et al.).

In the course of our applications to models of the NEP class, we found problems with both approaches. The scaling approach was found to be inflexible, since the welfare effects of advertising were found to depend strongly on whether demand was elastic or inelastic. A translating approach, in which advertising modifies the intercept parameters of the share equations, is consistent with previous studies of demand response to advertising. However, the introduction of any demand shifters in the model in this fashion means that the elasticities and welfare effects become dependent on the choice of units for quantities and prices (Alston, Chalfant, and Piggott 1999c): the estimated parameters are not invariant to the scaling of the data. In the jargon, the model violates the property that Pollak and Wales (p. 70) called "closure under unit scaling." A brief demonstration follows.

In matrix notation, the Almost Ideal model can be expressed as

$$w = \alpha + \Gamma \hat{p} + \beta \ln(M/P)$$

where w denotes the vector of budget shares, p denotes the vector of prices, M is total

expenditure, \hat{p} denotes a vector of logarithms of prices, and

$$\ln P = \delta + \alpha' \hat{p} + (1/2) \hat{p}' \Gamma \hat{p}.$$

Homogeneity, symmetry, and adding-up are imposed by the familiar restrictions

$$\iota' \alpha = 1, \quad \iota' \Gamma = 0, \quad \iota' \beta = 0, \quad \Gamma = \Gamma'$$

where ι denotes a vector of ones. When an intercept shifter such as advertising expenditures (A) is included in the model, the new model is

$$w = \alpha_0 + \phi A + \Gamma \hat{p} + \beta \ln M - \beta [\delta + (\alpha_0 + \phi A) \hat{p} + (1/2) \hat{p}' \Gamma \hat{p}].$$

Suppose we change the units of measurement by multiplying quantities by π_i and dividing prices by π_i . We showed in Alston, Chalfant, and Piggott (1999c) that the demand system becomes

$$w = \tilde{\alpha}_0 + \tilde{\phi} A + \tilde{\Gamma} (\hat{p} - \hat{\pi}) + \tilde{\beta} \ln M - \tilde{\beta} [\tilde{\delta} + \tilde{\alpha}'_0 (\hat{p} - \hat{\pi}) + A \cdot \tilde{\phi}' (\hat{p} - \hat{\pi}) + (1/2) (\hat{p} - \hat{\pi})' \tilde{\Gamma} (\hat{p} - \hat{\pi})].$$

Collecting the terms that involve $\hat{\pi}$, the share equations become

$$w = \bar{\alpha}_0 + \tilde{\phi} A + \tilde{\Gamma} \hat{p} + \tilde{\beta} \ln M - \tilde{\beta} [\bar{\delta} + (\bar{\alpha}'_0 + \tilde{\phi} A)' \hat{p} + (1/2) \hat{p}' \tilde{\Gamma} \hat{p}]$$

where $\bar{\alpha}_0 = \tilde{\alpha}_0 - \tilde{\Gamma}' \hat{\pi}$ and $\bar{\delta} = \tilde{\delta} - \bar{\alpha}'_0 \hat{\pi} - (1/2) \hat{\pi}' \tilde{\Gamma} \hat{\pi} - A \tilde{\phi}' \hat{\pi}$. Notice that $\bar{\delta}$ is not constant, because the term $A \tilde{\phi}' \hat{\pi}$ varies with the data, and so the model with the prices rescaled is not equivalent to the original model: estimated coefficients and thus elasticities and welfare measures will depend on the units chosen for measuring quantities.

In Alston, Chalfant, and Piggott (1999c), we described two solutions, one of which we have tried empirically. Either the troublesome $\bar{\delta}$ parameter must vary with A or the Almost Ideal demand system should be generalized, as suggested by Bollino, to include pre-committed, or subsistence, quantities. We can define the subsistence quantities to be functions of demand shifters without introducing any dependence on scaling.

Illustrative Results for U.S. Meat Advertising

Next, we present summary results from the Alston, Chalfant, and Piggott (1999b) model

of the demand for meat in the United States, with generic advertising of beef by the Beef Industry Council (BIC), and pork by the National Pork Producers Council (NPPC). In this empirical work, advertising variables were incorporated as modifiers of the “pre-committed” quantity parameters in a Generalized Almost Ideal demand system, a type of translating. Piggott applied the same approach in the other functional forms nested in the NEP model that incorporate subsistence quantities (see also Alston, Chalfant, and Piggott 1999d). Simulations were conducted using the estimated demand system, a calibrated supply system, and calibrated export demand equations.

The supply equations were parameterized by assuming a constant elasticity functional form and using a matrix of estimates of own- and cross-price elasticities of supply taken from Roningen, Sullivan, and Dixit (p. 74). Export demand equations were parameterized by assuming a constant elasticity functional form, with export demand elasticities of -5 for each commodity. The supply and export demand equations were treated as deterministic, so that they did not contribute any variability to the Monte Carlo simulations, and uncertainty about these parameters values is not incorporated in the distributions of elasticities and welfare effects.

Table 1 shows the welfare effects of 1% changes in BIC beef advertising, on the left, or NPPC pork advertising, on the right, holding the check-offs constant. The own-commodity effects on producer welfare are large. Alston, Chalfant, and Piggott (1999b) report other results on the incidence of the check-offs, which show that the effects of a 1% increase in either beef or pork promotion are much greater than the effects of a 1% increase in the corresponding check-off, as would be required to finance the increase in promotion. The implied marginal benefit–cost ratio for beef producers from beef advertising is high, about 15:1, and the marginal benefit–cost ratio for pork producers from pork advertising is even higher, over 200:1.

The cross-commodity effects of advertising are mostly, but not all, negative. An increase in beef advertising benefits beef producers partly at the expense of pork and poultry producers, and an increase in pork advertising benefits pork producers partly at the expense of beef producers, but in a multimarket equilibrium, pork advertising also benefits poultry producers. Taking account of the

generally negative cross-commodity effects, it can be seen that the net effects on producers as a group (a gain in the case of beef advertising, but a loss in the case of pork advertising) are much smaller than the benefits to the producers undertaking the advertising—the distributional effects are larger than the net welfare effects. This observation is reinforced when we take into account consumer welfare effects, which dominate the effects on total welfare.

Consumer welfare is reduced by an increase in either type of advertising, as well as by the check-offs used to finance the advertising. The consumer loss is large relative to the beef producer gain from beef advertising. The consumer loss from pork advertising is of a similar magnitude to the gain to pork producers (and the loss to beef producers). These results mean that taking account of the consumer welfare effects can change the policy implications substantially.

Since the estimated parameters of the demand model underlying the elasticities are random variables, so, too, are the welfare measures. Along with point estimates, we computed posterior distributions of each of the welfare measures, using 1,000 draws of vectors of parameter values that were consistent with the restrictions for monotonicity and concavity at every data point. Table 1 shows the point estimates for a 1% increase in either type of advertising, holding the check-offs constant, along with the corresponding posterior means and standard deviations.

The posterior means are generally similar to the corresponding point estimates. We are also interested in the precision of the estimates of welfare effects. It can be seen that, in the case of beef advertising, none of the producer or consumer welfare effects are statistically significantly different from zero, in the sense that confidence intervals constructed from the empirical posterior distributions for these measures always include zero. This reflects the fact that some of the parameters measuring demand response to BIC advertising were not measured with great precision. The effects of pork advertising by the NPPC were measured precisely enough such that we can be confident about the signs of the effects on welfare of beef producers, pork producers, and meat producers as a group, but the low precision of the estimated effect of pork advertising on consumer welfare meant that the large negative estimated effect on total welfare was not significantly different from zero.

Table 1. Welfare Effects of Meat Advertising, \$ million, 1979(1)–1995(2)

	Effects of a 1% Increase in			
	BIC Advertising		NPPC Advertising	
	Point Estimate	Posterior Mean (Standard Dev.)	Point Estimate	Posterior Mean (Standard Dev.)
Producer surplus				
Beef	31.34	39.77 (43.17)	-165.03	-160.65* (68.39)
Pork	-1.46	3.68 (30.47)	111.37	116.68* (51.89)
Poultry	-27.58	-41.98 (37.74)	32.04	22.03 (50.86)
Total producer surplus	2.29	1.47 (5.05)	-21.62	-21.94* (8.91)
Consumer welfare	-165.51	-217.71 (230.66)	-148.22	-222.65 (324.11)
Tax revenues	-3.29	-3.28* (0.02)	-1.18	-1.17* (0.02)
Total welfare	-166.50	-219.52 (230.29)	-171.02	-245.75 (323.30)

Notes: The posterior means and their standard deviations were computed from 1,000 draws that satisfied monotonicity and curvature restrictions at every observation. * denotes estimates that were significantly different from zero at the 5% significance level.

The consumer welfare change is equal to the negative of the compensating variation for the policy change in question.

The additional advertising is charged against "tax revenues," which can be thought of as assets held by the Council in question. Further, although the check-off rates are constant, there may be small changes in check-off revenue arising from induced demand shifts.

Conclusion

The economic analysis of generic advertising has been limited to identifying its effects on demand and producer welfare, but an incomplete picture is obtained if we ignore the effects of raising check-off funds and the effects of advertising on other producers and consumers (or general taxpayers, when government spending is affected). In this paper and elsewhere, we have argued that it is both appropriate and feasible to broaden the economic analysis and the policy discussion to a consideration of the effects on social welfare of generic advertising funded by check-offs.

In addition to making better choices about what effects to try to measure, we want to make informed choices about how to measure them. Specification choices affect measures of the demand response to advertising, as well as findings about total welfare and its distribution. Results depend on how advertising is measured, what goods are included, and many other factors that reflect decisions made by the analyst. Our work to date has emphasized functional form choices, and we have found that simpler functional forms for demand are typically rejected when nested within more

complicated models. It does not follow that estimated effects of advertising on demand or welfare are fragile, but they might be, which provides an additional reason, beyond concern over specification error, to estimate a variety of models and to examine the differences among them. Our work suggests that there is a trade-off between bias and precision in estimating both advertising effects and welfare measures. Hence, even though we are concerned about fragility and bias, it may not be an optimal response to simply apply more flexible models. As always, the challenge in applied econometrics is to extract information from imperfect data. The problems are especially pronounced in the present setting, because the effects of advertising are complex, poorly understood, and small.

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