Advertising and Consumer Welfare: Scaling versus Translating

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ABSTRACT. Controversy has surrounded the welfare effects of advertising, mainly concerning the consumer welfare effects. Unfortunately, the measures of consumer welfare effects in most studies have been ad hoc and incorrect. The consumer welfare consequences of advertising can be measured consistently when consumer demand equations are derived from an expenditure function. This is illustrated using the Almost Ideal demand system, which is popular in econometric estimation of food demand systems. An empirical application uses data on Australian meat consumption to evaluate generic advertising of meats. The results from using a theoretically correct money-metric measure of consumer welfare effects, taking account of cross-commodity effects of advertising and price changes, are compared with ad hoc approaches that some previous studies have proposed. In addition, the consumer welfare measures are combined with measures of producer benefits in order to compute private and social returns.

Key Words: advertising; consumer welfare; social welfare; Almost Ideal demand system

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I. Introduction

Advertising is controversial. Since the benefits are uncertain, one issue is simply the cost—Americans spent $130.1 billion on advertising in 1990 (Tremblay and Tremblay 1995), over 2 percent of Gross National Product. Other concerns relate to the consequences of advertising. Intuition and reason suggest that false advertising is likely to be socially wasteful, and it is illegal. Advertising of "bads" such as cigarettes has been condemned and heavily regulated or banned in many places. Beyond these relatively simple cases, a distinction has been drawn between purportedly good, informative advertising and purportedly bad, persuasive advertising—although the practical usefulness of the distinction is not clear. Regardless of whether it is true or false, or whether it is persuasive or informative, some have contended that advertising is socially wasteful, or at least excessive from a social welfare standpoint, owing to its role in exacerbating distortions from the exercise of market power.[1]

Another issue is the distribution of benefits and costs, the central issue in a number of recent legal disputes over mandatory commodity promotion programs, including the *Wileman Brothers* case that was heard before the U.S. Supreme Court in late 1996. Although these disputes have concerned the total benefits and costs and their distribution, the emphasis has been on different producer groups, and no attention has been paid to the interests of consumers. The public policy debate has thus been based on incomplete, partial welfare measures.[2]

It is usually presumed that the producers investing in the advertising are able to judge their own interests, and measuring the producer welfare effects is not controversial. Progress in resolving the issues concerning the social worth of advertising has been constrained, however, by the limitations of economic models for measuring the effects of advertising on consumer welfare. While an extensive literature on the evaluation of producer benefits from advertising now exists, the literature has not effectively resolved the question of how to measure the consumer benefits, let alone whether the consumer gains or loses from advertising. This helps to account for why the consumer welfare consequences have been neglected in commodity promotion policy discussions to date.

A theoretically sound and empirically tractable framework for the analysis of benefits from advertising is needed. This paper presents such an approach, one that captures both producer and consumer welfare consequences of advertising, that can be applied when consumer demand equations are derived from an expenditure function. We consider the implications of alternative ways of incorporating advertising, and we present illustrative empirical results from an Almost Ideal model of the demand for meat in Australia, with generic commodity advertising funded jointly by the beef and lamb industries.

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[1] For instance, see Galbraith (1958, 1971), Dixit and Norman (1978, 1979), and Tremblay and Tremblay (1995).

[2] The same disputes also led to a new requirement, in the 1996 Farm Bill, that mandatory commodity promotion programs under Federal marketing orders must be evaluated regularly, but consumer welfare appears to have been neglected here as well.

II. Theoretical Models of Consumer Benefits from Advertising

Notions of how advertising affects consumer welfare and how advertising affects demand are intimately related. Most studies have either considered advertising in the context of utility functions, or incorporated advertising in the demand functions, without linking the two. The formal linkage is often not possible, since only the simplest utility functions will yield explicit solutions for demand equations while, conversely, many popular forms for demand equations are not integrable. However, using a demand system derived from an expenditure function means that it is possible to explicitly link an econometric model of consumer demand to a money-metric measure of welfare change. Thus, we can (indeed must) decide jointly, in effect, how advertising enters demand equations and how it affects consumer welfare. Studies that have not connected the demand functions directly to consumer utility have either ignored consumer welfare or used arbitrary assumptions to attempt to approximate consumer welfare effects.

Dixit and Norman's Model of Consumer Benefits

In one of the better-known contributions to the economic literature on advertising, Dixit and Norman (1978) treated advertising as changing consumer tastes. Arguing that welfare could not be measured when tastes change, they opted for measuring consumer welfare changes from advertising using either the preadvertising or postadvertising tastes, held constant. An unsatisfactory implication of Dixit and Norman's (1978) approach is that the only effect on consumer welfare is through induced price changes. Since, in their model, privately profitable advertising leads to a higher price of the advertised good, welfare of consumers necessarily falls when they demand more in response to advertising. It follows that advertising is excessive.

Fisher and McGowan (1979) commented that Dixit and Norman (1978) had overstated their results, since they had not counted the implications of having advertising itself in the utility function. In their reply, Dixit and Norman (1979, p. 72[illegible]) acknowledged that "The real point at issue is, therefore, whether advertising is itself an object of preferences, or whether it merely shifts preferences over goods. We suspect that knowledge of the consequences of adopting the latter position as in D-N will make some people plump for the former view." Consistent with that prediction, Becker and Murphy (1994) argue for treating advertising as a good in its own right, and one consequence is that conventional welfare measures may be applied.[3]

Advertising in the Consumer Expenditure Function

The literature has suggested three types of specifications of advertising in demand models. These are (a) the treatment of advertising as a good in its own right, affecting utility both directly and through complementary relationships with other goods, as proposed by Becker and Murphy (1993); (b) a *scaling* approach, in which advertising changes the *effective* quantities and prices of goods, as used recently by Brester and Schroeder (1995); and (c) the use of a varying-parameter specification, a *translating* approach, in which the coefficients of a static model are themselves functions of advertising (e.g., Goddard and Amuah 1979; Piggott, Chalfant, Alston, and Griffith 1996 (hereafter PCAG)). These three specifications may be represented in a consumer expenditure function as

$$\text{(a) } C = c(u, \mathbf{p}, \mathbf{A} \mid \alpha), \text{ (b) } C = c(u, \tilde{\mathbf{p}}(\mathbf{A}, \mathbf{p}) \mid \alpha), \text{ and (c) } C = c(u, \mathbf{p}, \tilde{\alpha}(\mathbf{A})),$$

[3] Telser (1962, 1964) provided an earlier analysis of advertising as a part of given consumer preferences.

where C is the minimum consumer expenditure necessary to achieve utility, u, given a vector of market prices of goods, $\mathbf{p}$, a vector of exogenous quantities of advertising, $\mathbf{A}$, and a vector of parameters, α. In the first approach, advertising is a quasi-fixed consumption good.[4] In the second (scaling) approach, the cost function is defined in terms of effective prices, $\tilde{\mathbf{p}}$, which depend on actual prices and advertising, and utility comes from the corresponding effective quantities, $\tilde{\mathbf{x}}$, that depend on actual quantities and advertising.[5] In the translating (or varying parameter) case, the parameters, $\tilde{\alpha}$, depend on the quantities of advertising.

The three alternatives are not necessarily mutually exclusive. All three might be combined by defining the expenditure function as

$$C = c[u, \tilde{\mathbf{p}}(\mathbf{A}, \mathbf{p}), \tilde{\alpha}(\mathbf{A}), \mathbf{A}] = c(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) .$$

A specific expenditure function can be thought of as belonging to this general class, or to one of the three nested sub-classes of expenditure functions.[6] There is no particular reason to prefer any one of these three alternatives. However, the different ways to incorporate advertising may imply different empirical results in a particular application, depending on other aspects of the model. We explore these implications, in the Almost Ideal demand system, in a later section.

When the expenditure function is defined as

$$C = c(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}), \tag{1}$$

the corresponding Hicksian demand equations are given by the application of Shephard's lemma:

$$\tilde{x}_i = \frac{\partial C}{\partial \tilde{p}_i} = \frac{\partial c(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})}{\partial \tilde{p}_i} = h_i(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}), \tag{2}$$

where $\tilde{x}_i$ is the *effective* quantity of the ith good demanded, corresponding to the definition of the effective prices. These Hicksian demand equations nest all three alternative approaches for modeling the effects of advertising. However, they contain unobservable utility, u. If we can eliminate utility from the demand equations, we can derive Marshallian demand equations that are empirically tractable. This is possible whenever the expenditure function is of the Gorman Polar form (e.g., Deaton and Muellbauer 1980b, p. 144)

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[4] Becker and Murphy (1993) allow for advertising to be chosen by consumers, rather than firms, in some settings. Here the advertising is treated as being chosen by firms rather than consumers. The alternative treatment, consumers choosing quantities of advertising, is clearly possible in the expenditure function approach, but is not dealt with here. In that treatment, $\mathbf{p}$ would include the price of the advertising good, and $\mathbf{A}$ would not appear as a separate argument—effectively a quasi-fixed input to producing utility—as it does in the text equations.

[5] For instance, we can define the effective price of good i as $\tilde{p}_i = p_i\phi(A_i)$ and the effective quantity as $\tilde{x}_i = x_i/\phi(A_i)$, where $\phi(\cdot)$ is a type of quality index that measures the physical quantity required to provide an effective unit of the good, so that actual expenditure equals effective expenditure: $\tilde{p}_i\tilde{x}_i = p_ix_i$. Hence, advertising that increases the perceived quality of good i, $\phi'(\cdot) < 0$, raises its effective quantity for a given actual quantity, and lowers its effective price, leading to a corresponding increase in consumption.

[6] In some cases, however, it may not be obvious from the specification which role advertising is meant to play (say, the role of an intercept shifter or a good in its own right), although restrictions on the parameters may make it possible to distinguish.

$$\mathrm{c}(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) = \mathrm{a}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) + u\mathrm{b}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}). \tag{3}$$

In this case, we can use the familiar identity, $\mathrm{c}(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) \equiv M$, and substitute

$$u = \frac{\mathrm{c}(u, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) - \mathrm{a}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})}{\mathrm{b}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})} = \frac{M - \mathrm{a}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})}{\mathrm{b}(\tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})} = \psi(M, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}) \tag{4}$$

for u in the Hicksian demand equations, to obtain their Marshallian counterparts:

$$\tilde{t}_i = \mathrm{h}_i\{\psi(M, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}), \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A})\} = \mathrm{g}_i\{M, \tilde{\mathbf{p}}, \tilde{\alpha}, \mathbf{A}\}. \tag{5}$$

For estimation, all that remains is to select a functional form for g(·). As flexible a functional form as is desired can be used, maintaining contact with the underlying theory, by the choice of a(·) and b(·).[7] Demand equations corresponding to any of the three specific alternative treatments of advertising can be derived as special cases of equations (1) through (5).

After the parameters have been estimated, these Marshallian demand equations can be used with a corresponding set of supply equations to simulate the effects of changes in advertising on quantities and prices of all of the goods. Estimating the parameters of the demand functions yields estimates of the parameters of the expenditure function from which they were derived, and the expenditure function can be used to evaluate the consumer welfare effects of the changes in advertising and the induced changes in prices and parameters.

Using the superscript 0 to denote the initial values and 1 to denote the final values of variables, the compensating variation (CV) for a change in advertising from $\mathbf{A}^0$ to $\mathbf{A}^1$ is

$$CV = \mathrm{c}\{u^0, \tilde{\mathbf{p}}^1, \tilde{\alpha}^1, \mathbf{A}^1\} - \mathrm{c}\{u^0, \tilde{\mathbf{p}}^0, \tilde{\alpha}^0, \mathbf{A}^0\}, \tag{6}$$

where u^0 is the value of utility obtained by fixing $\tilde{\mathbf{p}}$, $\tilde{\alpha}$, and $\mathbf{A}$ in equation (1) at their initial values.[8] This measure of the welfare change from advertising is both theoretically sound and empirically useful. Empirical application requires specifying a particular functional form for the expenditure function, and a decision about how advertising enters.

The functional form decision is usually handled by choosing a flexible functional form arbitrarily, or by conducting an ad hoc search across forms. Here we are restricted to the Gorman polar form, and we will focus on the Almost Ideal demand system. Any other system derived from the Gorman polar form (including generalizations of the Almost Ideal demand system (e.g., Bollini 1987; Bollini and Violi 1990; Lewbel 1989) could be used instead.

It is difficult to make a strong case for preferring any particular approach to incorporating advertising. One criterion could be a prior view about how advertising affects

[7] None of this development is new, apart from the treatment of parameters and effective prices as functions of advertising, which does not change anything else materially. The best-known example of this type of derivation is the Almost Ideal demand system of Deaton and Muellbauer (1980a, 1980b).

[8] Alternatively, the equivalent variation measure would be obtained by fixing utility at u^1—the value given by fixing $\tilde{\mathbf{p}}$, $\tilde{\alpha}$, and $\mathbf{A}$ in equation (1) at their final values.

demand or utility. In the context of empirical demand models, however, a discussion of whether and how advertising changes tastes seems pointless (or, at least, unhelpful). Regardless of which approach to incorporating advertising is chosen, changes in the quantity of advertising will affect the utility from given quantities of the other goods, and thus will affect the positions and shapes of the demand curves for the other goods. Since we have nested all three approaches in a general expenditure function (and resulting demand system), it is an empirical question as to how the demand curves change, and which specification seems to fit the data best.

The first approach, (a), treating advertising as a good in its own right, has been advocated by Becker and Murphy (1993) as a way of thinking about advertising, but not necessarily as a suitable specification for econometric modeling of demand response to advertising. The second approach, (b), in which advertising changes the effective prices and quantities of the goods, can be regarded as a type of *scaling*, while the third approach, (c), in which advertising changes the parameters of the expenditure function, can be regarded as a type of *translating* (e.g., Pollak and Wales 1992). The second approach has not been used often, while the third approach has been common in studies of food demand response to advertising.[9] In what follows, we consider the translating and scaling approaches in the context of the Almost Ideal demand system, which we use for the empirical part. We do not consider further the approach in which advertising is treated as a separate good, in its own right.

III. Incorporating Advertising in the Almost Ideal Demand System

To implement an empirical model based on an expenditure function, with a view to measuring the effects of advertising, we must use a model of the form shown in equation (3). The best-known example of this form is the Almost Ideal demand system, which has been used to measure the demand response to advertising, but not the consumer welfare effects. Deaton and Muellbauer (1980a) parameterized the Almost Ideal expenditure function as

$$\ln c(u, \mathbf{p}) = \ln P + u\beta_0 \prod_{k=1}^{n} p_k^{\beta_k} \tag{7}$$

where P is defined as

$$\ln P = \alpha_0 + \sum_{j=1}^{n} \alpha_j \ln p_j + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j . \tag{8}$$

Corresponding share equations are derived using the logarithmic version of Shephard's lemma:

Applying the same approach to the expenditure function in equation (1) yields the same share equation with tildes over the parameters (α_i, β_i, and γ_i) and the prices (p_j and P):

[9] Sometimes, as in simple ad hoc single-equation models, it is not clear whether advertising is meant to play the role of a separate good or a modifier of an intercept parameter; the two ideas can be observationally equivalent. Some studies have included advertising in effect as a modifier of parameters in complete systems of demand equations: for example, Cox (1992); Duffy (1987); Goddard and Amuah (1979); Goddard and Tielu (1988); Green, Carman, and McManus (1991); Piggott, Chalfant, Alston, and Griffith (1996).

$$w_i = \frac{p_i x_i}{M} = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(M/P). \tag{9}$$

$$w_i = \tilde{\alpha}_i + \sum_{k=1}^{n} \tilde{\gamma}_{ik} \ln \tilde{p}_k + \beta_i \ln\left(M/\tilde{P}\right). \tag{9'}$$

Particular special cases, including those in previous studies of advertising using Almost Ideal demand systems, can be generated by eliminating some tildes (and thus treating some parameters as fixed, or some effective prices as equal to actual prices, or both).[10]

In econometric estimation, in order to preserve the theoretical properties of the model, restrictions must be imposed on the modified parameters (to impose symmetry, adding up, and homogeneity). The adding-up restriction is crucial. It reflects the fact that, with a fixed consumption budget, when advertising increases the demand for any one good, it must simultaneously reduce the demand for at least one other good. This fact may be overlooked in single-market evaluations of consumer welfare effects of advertising. Recognizing that effective advertising *necessarily* results in decreases in demand for some good(s) as well as increases in demand for some other good(s), it is difficult to form prior views on the direction of any welfare effects, and intuition based on single-market models is likely to be misleading.

Welfare Analysis using the Almost Ideal Model

Taking CV as our welfare measure,

$$CV = c(u^0, \tilde{\mathbf{p}}^1, \tilde{\alpha}^1) - c(u^0, \tilde{\mathbf{p}}^0, \tilde{\alpha}^0) = \Delta C. \tag{10}$$

Substituting the relevant expenditure functions for the Almost Ideal model yields

$$CV = e^{\left(\ln \tilde{P}^1 + u^0 \beta_0 \prod_{k=1}^{n} \left(\tilde{p}_k^1\right)^{\beta_k}\right)} - M^0, \tag{11}$$

where M^0, $\tilde{\mathbf{p}}^0$, $\tilde{\alpha}^0$, and $\tilde{P}^0$ refer to the actual values of expenditure, prices, parameters, and the price index, given the actual vector of advertising expenditures $\mathbf{A}^0$, and $\tilde{\mathbf{p}}^1$, $\tilde{\alpha}^1$, and $\tilde{P}^1$ refer to the hypothetical values of prices, parameters, and the price index, given the hypothetical advertising expenditure, $\mathbf{A}^1$.[11] From equation (4) and equation (7),

[10] As the equations above show for the general case, once advertising variables are included in an integrable demand system of this class, specific results follow directly for the expenditure function and consumer welfare. Hence, any previous studies using the Almost Ideal demand system to measure demand response to advertising have provided implicit results on consumer welfare effects of advertising, but to date no one has recognized this link from the effects of advertising on demand equations back to the underlying expenditure function.

[11] Note that one parameter, β_0, is treated as unaffected by advertising. If this parameter were affected by advertising, then there would be a change in the utility from consumption of all goods, in proportion (i.e., it effectively rescales utility). This does not seem to be a relevant possibility, and, in any event, could not be handled, since β_0 is not estimable. Knowing β_0 would amount to knowing cardinal preferences.

$$u^0 = \frac{\ln M^0 - a(\tilde{p}^0, \tilde{\alpha}^0)}{b(\tilde{p}^0, \tilde{\alpha}^0)} = \frac{\ln\left(M^0/\tilde{P}^0\right)}{\beta_0 \prod_{k=1}^{n} \left(\tilde{p}_k^0\right)^{\beta_k}}.$$

Then, substituting for u^0 in equation (11) yields

$$CV = e^{\left(\ln \tilde{P}^1 + \ln\left(M^0/\tilde{P}^0\right)\prod_{k}^{n}\left(\tilde{p}_k^1/\tilde{p}_k^0\right)^{\beta_k}\right)} - M^0. \tag{12}$$

Everything in equation (12) is either observable or estimable. This expression can thus be used to evaluate the consumer welfare consequences of advertising that affects any of the parameters of the conventional Almost Ideal demand model, or that changes any of the effective prices, accounting for the advertising-induced actual price changes as well as the other effects of advertising on consumption and welfare. We now consider the implications of two alternative ways of incorporating advertising for this welfare measure (scaling and translating).

A Varying-Parameters, Translating Approach

Adding advertising as a separate variable in the model seems to be an obvious place to start, and can be thought of as allowing the intercept to shift. Suppose, like PCAG, we assume an Almost Ideal model in which each α_i is a linear function of the quantity of advertising of each of the n goods,[12] but other parameters are unaffected so that

$$\tilde{\alpha}_i = \alpha_{i0} + \sum_{k=1}^{n} \alpha_{ik} A_k. \tag{13}$$

While this approach is consistent with previous studies of demand response to advertising, and is clearly practicable, allowing advertising to change just the intercepts entails some problems. Specifically, the consumer welfare measure is not invariant with respect to the units chosen for quantities (and thus prices) of the goods in the demand system.

To see this, consider equation (12) in the case where prices are unaffected by advertising:

$$CV = e^{\left(\ln P^1 + \ln\left\{\frac{M^0}{P^0}\right\}\right)} - M^0 \quad \text{and} \quad \frac{CV}{M^0} = e^{\left(\ln P^1 - \ln P^0\right)} - 1. \tag{14}$$

The change in consumer welfare depends only on the change in the value of the price index (P changes in this specification, even with fixed prices, because the parameters in P are

[12] A_k might be transformed as a square-root or logarithm and might involve a distributed lag, but these choices (which have implications for diminishing returns to advertising, and persistence effects) are unimportant for the discussion of the general implications of including advertising variables as modifiers of parameters.

affected by advertising). In turn, given the parameterization in (13), the change in the price index (which is the change in the expenditure function, given fixed prices) is given by

$$\ln P^1 - \ln P^0 = \sum_{j=1}^{n}\sum_{k=1}^{n} \alpha_{jk}(A_k^1 - A_k^0)\ln p_j . \tag{15}$$

Notice that, if the prices happen to be scaled so that are all equal, the adding-up restriction means that the sum is zero, since $\Sigma_j \alpha_{jk} = 0$. Alternatively, suppose that own advertising, A_k, increases the demand for good k ($\alpha_{kk} > 0$), and that units are such that good k has a relatively high nominal price. Then advertising of good k necessarily increases the cost of living index, P, and leads to a loss of welfare, even when the prices are constant (because advertising leads to an increase in the importance, in the price index, of the higher-priced good). The choice of units for quantities thus determines the implied results for consumer welfare, a fact that has not been recognized in previous studies.

To avoid this problem requires incorporating advertising in a different way, so that its effects on quantities are modified by prices—i.e., in the same way that Chalfant and Zhang (1996) have proposed to define nonparametric measures of biased technical change that are invariant to quantity units. For example, if advertising were involved through the γ_{ij} parameters, rather than the α_i parameters (i.e., the price slopes rather than the intercepts of the share equations), the measure of consumer welfare effects of advertising would be invariant with respect to quantity units of the goods Unfortunately, however, the necessity of preserving adding-up and symmetry restrictions among parameters means that it is not possible to change only one price slope in any equation, so that this approach can become expensive in terms of degrees of freedom.

An advantage of the scaling approach, considered next, is that it allows us to measure the effect of advertising a particular good by adding only one extra parameter per advertising variable, while still providing a measure of the welfare effects of advertising that is invariant to the units of quantities of goods. In addition, working with effective prices and quantities, rather than having the individiual price coefficients be functions of advertising, is likely to lead to results that are less complicated and easier to interpret.

Effective Prices and Quantities, A Scaling Approach

With scaling, the parameters are no longer dependent on advertising, which enters the model only through the effective prices. The Almost Ideal expenditure function is written in terms of effective prices as

$$\ln C = a(\tilde{\mathbf{p}}) + u\,b(\tilde{\mathbf{p}}), \tag{16}$$

and its elements take the form

$$a(\tilde{\mathbf{p}}) = \alpha_0 + \sum_{j=1}^{n}\alpha_j \ln\tilde{p}_j + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n}\gamma_{ij}\ln\tilde{p}_i \ln\tilde{p}_j = \ln\tilde{P} \tag{17}$$

and

$$b(\tilde{\mathbf{p}}) = \beta_0 \prod_{i=1}^{n}\tilde{p}_i^{\beta_i} .$$

The expenditure share equations are then

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln\tilde{p}_j + \beta_i \ln\left(M/\tilde{P}\right). \tag{18}$$

It remains to define the relationship between effective and actual prices. One simple definition is a constant elasticity form, in which advertising of good i affects only its own effective price, according to

$$\tilde{p}_i = A_i^{\theta} p_i,$$

or

$$\ln\tilde{p}_i = \theta_i \ln A_i + \ln p_i .$$

Substituting this form into equation (18) yields the following expenditure share equations:

$$w_k = \alpha_k + \gamma_{ki}\theta_i \ln A_i + \sum_{j=1}^{n} \gamma_{kj} \ln p_j + \beta_k \ln\left(M/\tilde{P}\right). \tag{19}$$

Advertising of good i effectively changes the intercepts of all of the share equations (according to the sizes of the cross-price coefficients, γ_{ij}), in a way that preserves adding-up, since $\Sigma_k \gamma_{ki}\theta_i \ln A_i = \theta_i \ln A_i \; \Sigma_k \gamma_{ki} = 0$ (automatically, by the homogeneity and symmetry restrictions). In addition, advertising has an "income effect" on demand, through the price index, which can be seen by expanding the $\ln\tilde{p}_i$ terms in $\ln\tilde{P}$ in equation (17):

$$\ln\tilde{P} = \alpha_0 + \sum_{j=1}^{n} \alpha_j \ln p_j + \frac{1}{2}\sum_{k=1}^{n}\sum_{j=1}^{n} \gamma_{kj} \ln p_k \ln p_j + \alpha_i \theta_i \ln A_i + \sum_{j=1}^{n} \gamma_{ij} \theta_i \ln A_i \ln p_j + \frac{1}{2}\gamma_{ii}\left(\theta_i \ln A_i\right)^2 \tag{20}$$

$$= \ln P + \theta_i \ln A_i \left(\alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \frac{1}{2}\gamma_{ii}\theta_i \ln A_i\right).$$

We can substitute parameters from equations (19) and (20) into the definition of CV, with appropriate transformations, to obtain a corresponding welfare measure. In this case, however, we cannot obtain simple expressions for the welfare change, even when we fix actual prices.

Notice that advertising enters the share equation first as an intercept shifter, much like the translating example considered above, in which the effects of advertising were shown to depend on the units for quantities. Here, however, changing quantity units does not affect the measured change in the effective price index, in (20), resulting from a change in advertising. This is so because the advertising effect in the jth share equation (19) enters not only in the intercept, α_j, but also as a product with the corresponding price coefficient, γ_{ki}. Changing the units will not change the marginal effect of advertising on the share, $\theta_i\gamma_{ki}$, and will not affect either of the component parameters, θ_i and γ_{ki}. In the price index, (20), the part of the advertising effect involving prices is the term $(\alpha_i + \Sigma_j \gamma_{ij} \ln p_j)$, which is invariant with respect to quantity units for the goods. It is this term that enters the computation of CV here; in the case of intercept shifts, only the α_i part was involved, and it was dependent on the quantity units.

IV. An Application to Australian Meat Demand

Several recent studies of meat demand in Australia have included measures of advertising by producer groups. The application here relates closely to the work of PCAG, using some of the same data. PCAG evaluated the effects of various specification choices on the measured demand response to meat advertising, treating meat as a weakly separable group, so that consumption of each meat (beef, lamb, pork, and chicken) depends only on meat group expenditure, the meat prices, and demand shift variables such as meat advertising, seasonal shifters, and trends.

We include advertising by beef and lamb producers (through the Australian Meat and Livestock Corporation, AMLC) but, unlike PCAG, we have omitted advertising by the Australian Pork Corporation, which PCAG found was ineffective (the inclusion of pork advertising did not change any of the qualitative results in this paper, either).[13] We also included a fifth good, representing consumer expenditure on all other (nonmeat) goods.[14] For each of the meats, quarterly data on nominal average retail prices in cents per kilogram and quarterly per capita consumption (disappearance) in kilograms, for 1978:3-1988:4 (42 observations), were used. The Consumer Price Index was used as the price of the fifth good, and the (implicit) quantity was calculated by dividing quarterly personal consumption expenditure on all nonmeat items by this index. Five quarterly observations (the current value and four lags) were included to capture the effects of real advertising expenditure ($A_{i,t}$) by the AMLC.

The Demand Model

In the Almost Ideal demand system, the equation for the budget share of the i^{th} good, with time-subscripted data, specified in terms of effective prices, is

$$w_{it} = \alpha_{it} + \sum_{j=1}^{n} \gamma_{ij} \ln \tilde{p}_{jt} + \beta_i \ln\left(M_t / \tilde{P}_t\right), \tag{21}$$

where, in time t, x_{it} = per capita consumption of good i, p_{it} = its price, $M_t = \Sigma_i\, p_{it} x_{it}$ is total quarterly per capita consumption expenditure, and $w_{it} = p_{it} x_{it} / M_t$, and

$$\ln \tilde{P}_t = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ln \tilde{p}_{kt} + \frac{1}{2} \sum_{k=1}^{n} \sum_{j=1}^{n} \gamma_{kj} \ln \tilde{p}_{kt} \ln \tilde{p}_{jt}.$$

The effective prices beef and lamb are defined in terms of observed prices and a four-quarter, free-form distributed lag of advertising expenditures, as follows:

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[13] As in PCAG, the advertising expenditure data were taken from Ball and Dewbre (1989). They represent the sum of real advertising expenditures in each of three media (television, radio, and print), calculated as nominal advertising expenditure deflated by a price index for each medium. Data on advertising were not available for chicken or for all other goods.

[14] The fifth good is included to avoid assuming separability of the meats group, so that our welfare measures are unconditional. They are, however, conditioned by the aggregation of all other goods, but some degree of aggregation over goods is inescapable. The data set does not satisfy the Generalized Axiom of Revealed Preference GARP using Varian's (1982) test procedure. As is typical of these tests, however, the violations of GARP do not suggest any particular type of structural change, and could also be dismissed as being due to measurement error.

$$\ln \tilde{p}_{it} = \ln p_{it} + \ln\left(1 + \phi_i \sum_{k=0}^{4} \omega_{it} A_{t-k}\right)$$

where A_{t-k} is the real quarterly AMLC advertising expenditure, lagged $k = 0$ to 4 quarters, and the lag weights are restricted to sum to one in each case ($\Sigma_k \omega_{jk} = 1$).[15] In a joint test, these ω_{jk} coefficients were not significantly different between lamb and beef, so we imposed $\omega_{1k} = \omega_{2k} = \omega_k$ for all k. The effective prices for the other three goods are equal to their observed prices. We introduce other demand shifters as modifications of the "intercepts" (α_i's) as follows:

$$\alpha_{it} = \alpha_{i0} + \tau_i T_t + \kappa_i T_t^2 + \sum_{m=1}^{3} \theta_{im} QD_{mt} ,$$

where T_t is a time trend set equal to 1 in 1978:3, and the QD_{mt}'s (m = 1, 2, or 3) are quarterly intercept dummies. The conventional parametric equality restrictions were applied as maintained hypotheses. In addition, the often-troublesome parameter, α_0, was fixed at zero for estimation.

Econometric Results

The model was estimated by nonlinear iterated seemingly unrelated regression with the MODEL procedure in SAS. The parameter estimates are reported in table 1, along with their standard errors and approximate t-statistics, and the corresponding elasticities of demand with respect to prices (uncompensated), total expenditure on all goods, and advertising.[16] (The elasticities were computed at every sample data point and we report the means.)

[Table 1: Almost Ideal Demand System Parameters]

As is generally true, the elasticities are more easily interpreted than the individual coefficients, although some of the coefficients are informative. Both trends and seasonality are statistically significant, as is typical in studies of demand for meats using quarterly data. All of the demand elasticities are of the expected signs, with the exception of a few instances of gross (and net) complementarity involving the nonmeat good. Most of these negative cross-price elasticities are quite small, with the exception of the elasticity of demand for chicken with respect to the price of nonmeat goods, which exceeds the own-price elasticity for chicken.

The advertising coefficients, ϕ_i, imply that AMLC advertising of beef and lamb increased the effective price of beef and reduced the effective price of lamb. As a result, the direct effect of AMLC advertising on demand, through changing the own effective price, was positive for beef and negative for lamb. This result seems counterintuitive, perhaps, but arises because the ϕ_i parameter is multiplied by the price coefficient, γ_{ii}, to determine the effect on

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[15] This just means that $\tilde{p}_i = p_i(1+\phi_i\Sigma_k\omega_k A_{t-k})$. It can be seen in this definition of effective prices that, when $\phi_i = 0$, $\tilde{p}_i = p_i$, when $\phi_i > 0$, an increase in advertising causes an increase in $\tilde{p}_i$, and when $\phi_i < 0$, an increase in advertising leads to a decrease in $\tilde{p}_i$.

[16] In their separable model of meat demand, PCAG estimated a general first-order autocorrelation correction. We found that including quadratic trends appeared to be a parsimonious way of accounting for dynamic effects, and each equation's residuals suggested that autocorrelation is not an important problem here. Of course, as always, our results are conditional on the particular dynamic specification chosen.

demand. Since the demands for both beef and lamb are inelastic ($\gamma_{11}, \gamma_{22} > 0$) a positive direct effect of advertising on demand would require $\phi_1 > 0$ for beef, and $\phi_2 > 0$ for lamb. These results illustrate the point that capturing advertising effects with only one parameter per good, in this case a parameter that interacts with price response parameters, is bound to imply some restrictions on how advertising affects demand and effective prices. In share equations, it means that advertising must increase the effective price to thereby increase the actual quantity demanded, when demand is inelastic.

In addition, since AMLC advertising affects the effective prices of both beef and lamb, the total effect on demand for beef and lamb involves cross-commodity effects of the effective price changes. The cross-commodity effects in this case are in opposite directions to the own price-effects (since the effects of advertising on the effective prices take opposite signs, $\phi_1 > 0$ and $\phi_2 < 0$, while $\gamma_{12} = \gamma_{21} > 0$). In other words, a lower effective price for lamb reduces demand for beef, offsetting to some extent the effects of a higher effective price for beef (which *increases* beef demand) while a higher effective price for beef increases demand for lamb, offsetting to some extent the effect of a lower effective price of lamb (which *reduces* lamb demand). For both beef and lamb, therefore, the net effect of advertising may be to increase or reduce demand, depending on the relative importance of the two effects working in opposite directions. As well as these direct and cross-commodity effects, there are real income effects (through the price index, $\tilde{P}$) of effective price changes, which are complicated and difficult to see from the regression coefficients alone.

Table 1 shows the elasticities of demand with respect to advertising, taking into account own- and cross-commodity effects, and income effects, of effective price changes, holding other variables (including actual prices) constant. The figures in the table are the averages of elasticities computed at every sample data point. The mean estimates across 42 data points have plausible signs (positive effects for the two advertised goods, beef and lamb, and pork; negative effects for chicken and the fifth, nonmeat, good) and sizes consistent with previous studies (0.066 for beef, 0.028 for lamb, 0.011 for pork, -0.046 for chicken, and -0.002 for nonmeat). Underlying these means are a range of estimates that are positive at every data point for beef, positive for all but the last two data points for lamb, positive for all but four data points for pork (including the last three), always negative for chicken, and negative for all but the last two observations for nonmeat. The last few observations involve the largest values for the advertising expenditure variable.

These elasticities refer only to the effects of advertising on the demands. In a multimarket equilibrium, the displacement of any one of the demand functions leads to price changes that feed through the related markets. Thus, even if AMLC advertising did not directly benefit pork producers, it might indirectly benefit them by inducing an increase in the prices of beef and lamb, which in turn would cause an increase in demand for pork. In turn, induced changes in pork prices would feed back and modify the effects on beef and lamb. In order to determine the full effects on demand, and from there on prices and economic welfare, we must combine the demand model with supply equations in a multimarket simulation.

Market Simulations

The parameters in table 1 are sufficient to define the demand side of a model, to be combined with supply equations and market-clearing conditions to conduct simulations of alternative advertising regimes, and determine values for the corresponding prices and quantities produced and consumed.[17] Then, the parameters of the Almost Ideal demand system can be combined with the simulated prices and quantities of advertising to compute the effects on consumer welfare. These results, combined with measures of changes in welfare of producers and taxpayers, yield measures of the net social welfare effects of changes in advertising.

The supply side of the model is defined by combining the values for prices and quantities produced with some values for supply elasticities taken from the literature, and constant elasticity supply equations for the four meats.[18] The parameterizations of the supply equations were based on the quantities generated from the demand model as predicted values when actual values were used for prices, expenditures, and advertising, rather than the observed quantities. These fitted quantities became the "actual" data as a starting point for simulating counterfactual scenarios.[19] The supply elasticities for the simulations are reported in table 2. In addition, since beef and lamb are traded internationally, constant-elasticity export demand equations were parameterized in the same way. The export demand elasticities for both beef and lamb were assumed to be equal to -5. These values are less elastic than the long-run values reported by Higgs (1986), who used -10 instead, but are reasonable for a simulation using quarterly data.

[Table 2: Parameters for Simulations]

The model was used to simulate the quantities and prices of the five goods using the actual values of advertising and other exogenous variables. This simulation simply reproduced the prices and quantities used to parameterize the model. Then the model was used to simulate three counterfactual scenarios at every data point: (a) a 1 percent increase in the levies on beef and lamb used to finance AMLC advertising, (b) a 1 percent increase in advertising by the AMLC, and (c) both (a) and (b). Levy rates and advertising expenditure on beef and lamb were held constant unless stated otherwise.

Table 3 reports the effects of a simulated 1 percent increase in AMLC advertising expenditure every quarter. The figures in the table are the average across all sample data points of the corresponding estimated prices, quantities, and expenditures. The base-level prices, quarterly quantities consumed, and expenditures on the five goods are denoted "initial" values. The table also shows the simulated percentage changes in prices, quantities, and

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[17] We use the point estimates of the parameters both in the simulations and in calculating the welfare measures.

[18] In Australia, beef and lamb are often produced together on multiple-enterprise, mixed cropping and grazing farms under dryland grazing conditions. Significant cross-price elasticities of supply arise from both complementarities in the use of certain factors (such as labor and different types of feed) and competition for the use of other resources, especially feed. The same is not true for the other livestock-producing industries. Both pork and chicken are produced in intensive production systems. The animals are housed. Although chickens and hogs both use feed grains, in Australia, world feedgrain prices are exogenous; hence, the industries are essentially independent on the supply side.

[19] This procedure removes the errors in fitting the demand model to real-world data from the comparative-static simulation, where we express results as percentage changes in predicted quantities. Since the demand system fits the sample data very closely, there was little absolute error between the predicted quantities from the demand model, used as the baseline, and the observed values. On the supply side, the "intercept" parameters were set at every data point to ensure that every supply function passes exactly through the baseline quantities. Thus the baseline simulation exactly replicates the observed prices and closely approximates the observed quantities.

expenditures for each of the five goods, and the corresponding "final" values for prices, quarterly quantities consumed, and expenditures on each good, associated with a 1 percent greater AMLC advertising expenditure. Virtually identical results were obtained when we simulated a 1 percent increase in AMLC advertising jointly with a 1 percent increase in the levies in the beef and lamb industry used to finance that advertising, which means that the effects of the simulated change in advertising dwarfed the effects of the levy used to finance it.

[Table 3: Simulated Prices, Quantities, and Expenditures]

Since we have simulated a 1 percent change in advertising, the simulated percentage changes can be interpreted as *total* elasticities of price, quantity, and expenditure with respect to AMLC advertising (e.g., Piggott, Piggott, and Wright 1995). These total elasticities are qualitatively similar to the *partial* advertising elasticities (δ_i) in table 1 but somewhat smaller, as would be expected. It can be seen that a 1 percent increase in AMLC advertising implies an increase in the beef price of 0.009 percent, an increase in beef quantity of 0.060 percent, and an increase in expenditure on beef of 0.069 percent (roughly equal to the sum of the percentage changes in price and quantity). For lamb and pork, like beef, increasing AMLC advertising would result in an increase in price, quantity consumed, and the value of consumption. However, chicken and nonmeat demand would decline, so that quantity consumed and expenditure on these goods would fall. Chicken is the only good whose price is induced to fall, and it falls by 0.035 percent. Consequently, expenditure on chicken falls by about 0.069 percent while expenditure on beef rises by about 0.069 percent in response to a 1 percent increase in AMLC advertising. If the purpose of advertising was to encourage consumers to switch back from chicken to red meat, especially beef, the policy may have been successful.

V. Welfare Evaluation

The simulated quarterly prices and quantities, as illustrated in table 3, are sufficient to compute measures of the welfare changes. The producer surplus measures due to the changes in prices are computed in the conventional ways, assuming constant elasticity supply functions. It is important to note that the producer surplus measures relate to total quantities produced, including exports of beef and lamb, while the consumer welfare measures relate only to domestic consumption.[20] In addition, taxpayer welfare changes are involved. In the simulations, the levy rates and the various advertising expenditures were both treated as exogenous, and any difference between levy income and advertising expenditures is assumed to be financed by taxpayers. Table 4 shows the welfare changes for each type of producer, for consumers, for taxpayers, and for the nation as a whole, due to the three alternative policy changes. All of the reported welfare changes are the means of quarterly changes over the period 1978:3 to 1988:4.

[Table 4: Welfare Measures]

[20] It seems reasonable to take a national perspective rather than a global one in the specific case, given the purposes for the beef and lamb check-offs laid out in the legislation. It would be reasonably straightforward to augment the national measures with measures of foreign "consumer surplus," measured off the export demand functions for beef and lamb, to obtain a global welfare measure.

To isolate the effects of the levies, consider the hypothetical scenario of increasing the beef and lamb levies used to finance the AMLC advertising by 1 percent, while preserving the advertising expenditure. This would lead to quarterly losses to beef producers (A$3,143) and lamb producers (A$1,237) but small gains to pork and chicken producers, arising from the increase in demand for these meats due to higher prices for beef and lamb, with an overall loss to producers of A$4,271; and, it would lead to a loss to consumers of A$465. However, it would also raise an additional A$5,6?4 in tax revenue which outweighs the combined losses to producers and consumers by A$898—a deadweight gain from taxation. The reason is that the production tax operates similarly to an export tax. Australia has some market power in trade in beef and lamb—given the export demand elasticities of -5—so that an export tax improves domestic welfare. A tax on domestic production, while not as effective as an export tax for exploiting market power in trade, can also yield net domestic benefits for similar reasons.

Now consider the effects of a 1 percent increase in AMLC advertising, holding the levies constant. The figures in table 4 show that a 1 percent increase in AMLC advertising expenditure in every quarter, while maintaining the levies on beef and lamb, would lead to a gain to beef producers of A$147,523, a gain to lamb producers of A$17,947, a gain to pork producers of A$1,859, and a loss to chicken producers of A$92,224, with a net gain to meat producers as a group of A$75,104. These producer welfare changes reflect both the direct effects of advertising on demand, and induced cross-price effects on demand.

The key result is that a 1 percent increase in AMLC advertising would also involve a loss to consumers of A$1,227,007. The consumer loss exceeds the producer gain, leading to a net social welfare loss of A$1,157,513. The consequences of increasing both the advertising and the AMLC levies are approximately equal to the sum of the effects of increasing one or the other (since the shifts are relatively small, effects are approximately additive), and little different from the effects of increasing the advertising without changing the levies (since the effects of the levies are, relatively, very modest).

Comparison to Previous Measures

How do the measures here compare with previous ideas for measuring the consumer welfare effects of advertising? Dixit and Norman (1978) suggested that the social welfare consequences of advertising could be approximated by the change in producer (monopoly) profit minus a term equal to the change in price multiplied by the preadvertising quantity. This last term represents the consumer welfare cost of advertising in their measure. Dixit and Norman (1978) conceived that measure to apply in a single-market model. In the model here, multimarket complications arise. Looking just at the beef market, the Dixit and Norman measure of the average quarterly benefits from a 1 percent increase in advertising would be approximately equal to A$147,523 of beef producer benefits (from table 4) minus $A70,358 of beef consumer losses, a net gain of A$77,165 per quarter.[21]

The measures in table 4 are not strictly comparable, since the consumer welfare effect is explicitly multimarket, but it can be seen that the measured net welfare effect is quite different between the two approaches. Adding up across the four markets, the Dixit and Norman measure would be equal to a total quarterly producer benefit of A$75,104 (from table 4) plus a total consumer gain of A$1,875. This estimate of consumer welfare change, a gain

[21] This figure for the consumer loss is obtained by multiplying each quarterly beef price change (dollars per kilogram) by the initial quarterly quantity (kilograms of beef per capita per quarter), times the population, and computing an average over the sample.

of A$1,875, is very different from the correct measure in table 4 (a loss of A$1.23 million per quarter). It is also quite different from the measure of consumer loss for the beef market alone, reflecting some additional small losses for pork and lamb consumers, but much greater gains for chicken consumers, from changes in prices induced by advertising.

The net gain from the 1 percent increase in advertising by this multimarket measure would be A$76,979. Notice that this is almost identical to the measure from the beef market alone. The reason is that the measures of producer and consumer welfare effects in other markets are approximately equal and opposite, since, for small price changes, they are defined as essentially transfers on a given quantity between producers and consumers. Another way to interpet these results is that the A$1.225 million difference between the total consumer welfare changes (a loss of A$1.227 million in table 4) and the component attributable just to the price changes (a gain of A$0.002 million) must reflect the component of consumer welfare changes associated with the advertising itself, left out of Dixit and Norman's (1978) formula.

VI. Conclusion

Previous studies of the benefits and costs of advertising have mostly skirted the question of the effects of advertising on consumer welfare. Most have concentrated on the question of benefits and costs to producers, especially the empirical studies. While the focus on producers is appropriate for measuring the private returns to advertising, a number of policy questions concern the social returns, involving a consideration of consumers and, perhaps, taxpayers as well as producers. The longstanding concerns about the social welfare consequences of advertising have led to attempts to tackle consumer welfare issues, but they have not resolved the question of how to incorporate advertising in demand models, and have not provided approaches for measuring welfare effects that are theoretically sound and empirically tractable.

This paper has shown that incorporating advertising variables into one of the more popular demand systems in the recent literature lends itself directly to an exact Hicksian money-metric measure of consumer welfare consequences of advertising. A number of recent studies have included advertising variables as modifiers of parameters (usually the intercepts) in expenditure share equations of the Almost Ideal demand system. This approach is not suitable for subsequent welfare measurement since, as we have shown, the resulting compensating variation measure depends on the units chosen for prices and quantities of the goods. Invariance with respect to quantity units is desirable and can be achieved easily, in a parsimonious specification, by treating advertising as something that changes the effective prices of goods—a scaling approach. Econometric estimates of the parameters of such models can be used to simulate market prices from hypothetical changes in advertising and the welfare consequences for consumers. The same approach could be used in any consumer expenditure function for which the parameters can be estimated. It remains to be seen how those measures can be used to explore more general questions about issues such as the socially wasteful or beneficial aspects of advertising. In addition, we have not fully determined the implications of the restrictions implied by the particular approach to scaling, combined with the Almost Ideal functional form, for consumer welfare measures

In an application to Australian meat demand, advertising of beef and lamb was found to lead to consumer welfare losses, and net losses to society, although it was beneficial for the beef and lamb producers who paid for it. These results demonstrate the importance of looking beyond producer benefits alone. In the Australian meat industry, there is a conflict of interest between red meat producers, who earn very high rates of return to their share of the costs of the levy to finance AMLC advertising, and the rest of the nation, including consumers, and producers of chicken and nonmeat goods. Even in a competitive industry, what is good for producers may not be good for the society as a whole. Hence, the current policy that provides producers with the legal powers to collect taxes to finance commodity promotion must be evaluated in terms of its implications for consumers and others, not just producers, if it is to be justified in terms of net social benefits rather than narrow sectional interest.

Our results differ markedly from those obtained by applying the approach proposed by Dixit and Norman (1978), which would indicate a net social benefit from advertising beef and lamb owing to much smaller estimates of the consumer welfare loss. In our particular example, the distributional effects are qualitatively similar to those that may be indicated using Dixit and Norman's (1978) method: consumers of beef and lamb lose; producers of beef, lamb, and pork gain; and chicken producers lose. But the quantitative differences are important: Dixit and Norman would find a small consumer welfare gain where we find a large consumer welfare loss, leading to a reversal of the finding concerning net social welfare consequences.

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Table 1: *Estimated Parameters of the Almost Ideal Demand System for Australia*

	Estimated Coefficient	Standard Error	"T" Ratio	Elasticity[d]
Intercepts				
α_{10}	-0.0142	0.1716	-0.08	
α_{20}	0.0319	0.0296	1.08	
α_{30}	0.0373	0.0294	1.27	
α_{40}	-0.0078	0.0214	-0.37	
α_{50}	1.0472	0.1910	5.48	
Linear Trends				
τ_1	-3.920E-4	1.569E-4	-2.50	
τ_2	3.199E-5	2.877E-5	1.11	
τ_3	-3.975E-7	3.366E-5	-0.01	
τ_4	-5.340E-6	2.500E-5	-0.21	
τ_5	3.658E-4	1.721E-4	2.12	
Quadratic Trends				
κ_1	-3.681E-7	2.974E-6	-0.12	
κ_2	-1.201E-6	5.262E-7	-2.28	
κ_3	-4.798E-7	5.897E-7	-0.81	
κ_4	8.322E-7	5.463E-7	1.52	
κ_5	1.217E-6	3.392E-6	0.36	
Seasonality				
θ_{11}	0.0059	0.0029	2.02	
θ_{12}	0.0031	0.0023	1.35	
θ_{13}	0.0049	0.0020	2.45	
θ_{21}	-0.0003	0.0005	-0.53	
θ_{22}	-0.0004	0.0004	-1.02	
θ_{23}	0.0008	0.0003	2.26	
θ_{31}	-0.0017	0.0005	-3.46	
θ_{32}	-0.0014	0.0004	-3.68	
θ_{33}	-0.0011	0.0003	-3.14	
θ_{41}	0.0004	0.0004	1.19	
θ_{42}	0.0001	0.0003	0.52	
θ_{43}	0.0003	0.0003	1.00	

Table 1: (continued)

	Coefficient	Standard Error	"T" Ratio	Elasticity
Prices				
γ_{11}	0.0104	0.0039	2.71	-0.62
γ_{12}	0.0026	0.0009	2.93	0.09
γ_{13}	0.0035	0.0010	3.34	0.12
γ_{14}	0.0011	0.0008	1.40	0.04
γ_{15}	-0.0176	0.0051	-3.46	-0.88
γ_{21}	0.0026	0.0009	2.93	0.31
γ_{22}	0.0013	0.0006	1.94	-0.83
γ_{23}	0.0025	0.0009	2.69	0.32
γ_{24}	0.0024	0.0007	3.44	0.28
γ_{25}	-0.0087	0.0018	-4.88	-0.62
γ_{31}	0.0035	0.0010	3.34	0.32
γ_{32}	0.0025	0.0009	2.69	0.25
γ_{33}	-0.0021	0.0021	-0.99	-1.18
γ_{34}	0.0017	0.0013	1.31	0.16
γ_{35}	-0.0056	0.0024	-2.35	-0.16
γ_{41}	0.0011	0.0008	1.40	0.16
γ_{42}	0.0024	0.0007	3.44	0.32
γ_{43}	0.0017	0.0013	1.31	0.23
γ_{44}	0.0049	0.0017	2.83	-0.32
γ_{45}	-0.0100	0.0022	-4.60	-1.77
γ_{51}	-0.0176	0.0051	-3.46	-0.02
γ_{52}	-0.0087	0.0018	-4.88	-0.01
γ_{53}	-0.0056	0.0024	-2.35	-0.01
γ_{54}	-0.0100	0.0022	-4.60	-0.01
γ_{55}	0.0420	0.0055	7.62	-0.95
Income				
β_1	0.0072	0.0282	0.26	1.26
β_2	-0.0039	0.0049	-0.80	0.52
β_3	-0.0041	0.0048	-0.84	[illegible]
β_4	0.0027	0.0035	0.77	1.38
β_5	-0.0020	0.0313	-0.06	1.00

Table 1: (continued)

	Coefficient	Standard Error	"T" Ratio	Elasticity
Advertising Lag Weights				
ω_0	0.4733	0.1467	3.23	
ω_1	0.1930	0.1325	1.46	
ω_2	0.0036	0.1454	0.02	
ω_3	0.0632	0.1552	0.41	
ω_4	0.2669	0.1435	1.86	
Advertising Effects				
ϕ_1	0.0022	0.0014	1.52	
ϕ_2	-0.0012	0.0003	-4.52	
δ_1				0.066
δ_2				0.028
δ_3				0.011
δ_4				-0.046
δ_5				-0.002

Notes:
The goods are 1=beef, 2=lamb, 3=pork, 4=chicken, 5=all other consumption goods. Parameters for the fifth equation were computed using the adding-up conditions across equations. Weights on the fourth lag of advertising expenditure were computed using the restriction that the weights sum to zero. Elasticities are the sample averages of ***uncompensated*** price elasticities, elasticities of demand with respect to advertising holding constant total expenditures, and elasticities with respect to total expenditures, computed at every data point. To conserve space, the elasticities are reported in the rows for the corresponding parameters primarily associated with them for price response (γ), response to total expenditure (β), and response to advertising expenditure (δ).

Table 2: *Elasticities of Supply for Simulations*

	Elasticities of Supply with Respect to Price of				
	Beef	Lamb	Pork	Chicken	Nonmeat
Quantity					
Beef	0.5	-0.1			
Lamb	-0.2	0.3			
Pork			1.0		
Chicken				1.0	
Nonmeat					∞

Source:
These elasticities are based on an informal review of various estimates in the literature. Elasticities for beef and lamb are from Hall, Fraser and Purtill (1988). Elasticities for pork and chicken are based on results from Wilcox (1989) for the pork industry which has similar economic characteristics to chicken. The index of nonmeat prices is assumed to be exogenous.

Table 3: *Total Elasticities of Prices, Domestic Consumption, and Expenditures With Respect to AMLC Advertising (Sample Means)*

Good	Prices ($/kg)			Quantities (kg/capita/quarter)			Expenditure ($/cap./quarter)		
	Initial Value	Percent Change	Final value	Initial Value	Percent Change	Final Value	Initial Value	Percent Change	Final Value
	Effects of a 1 Percent Increase in AMLC Advertising Holding Taxes and APC Advertising Constant								
Beef	4.893	0.009	4.893	10.618	0.060	10.624	50.956	0.069	50.992
Lamb	3.775	0.011	3.776	3.952	0.011	3.953	14.875	0.022	14.877
Pork	4.847	0.004	4.848	3.985	0.004	3.985	19.515	0.009	19.515
Chicken	2.466	-0.035	2.465	5.243	-0.035	5.241	13.042	-0.069	13.031
Nonmeat	4.057	0.000	4.057	426.662	-0.002	426.654	1,753.460	-0.002	1,753.440