Does Generic Advertising Wrap Demand Curvature?

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1. Introduction

This paper reconsiders the impacts of generic advertising on commodity prices induced through demand effects. Rather than considering a simple demand shift, we consider the possibility that advertising leads to a change in curvature of the demand curve. In this case, generic advertising is shown to affect both the level of market prices as well as their volatility. In general, advertising is taken as providing information to the consumers; the effect of the information is to reduce the cost of procuring the good's services. Two types of advertising have been used in the markets. Generic advertising is designed to change or reinforce consumer preferences and consumption habits. Brand advertising attempts to highlight a particular brand to encourage consumers to switch their consumption from other substitutes. Traditionally, advertising has been viewed as establishing or enhancing product differentiation and price competition, though the effects of advertising on a product's cost of information as a consumption determinant have not received consideration to date.

Evidence in hand suggests that the role of generic advertising deserves further attention. Brester and Schroeder (1995) concluded that generic advertising did not lead to a significant change in the demand for beef, pork, and poultry, but that brand advertising does impact consumption of these commodities. Goddard and Amuah (1989) found that the demand for individual fats and oils was significantly affected by generic advertising expenditures, whereas aggregate demand for fat and oils was found unresponsive to advertising, though affected by price and trend. In contrast, Rimal and Ward (1998) and Kaiser (1997) found significant impact of generic advertising for the use of retail flower outlets and dairy markets. In brief, results do not support a general conclusion about the impacts of advertising expenditures on demand.

This paper extends the specification of the role of advertising used in past studies to incorporate an effect on the curvature of demand. As an application, the paper limits its focus to generic advertising of beef and re-examines the role of advertising given a possible change in demand curvature. In addition, the econometric specification is extended to allow testing for existence of curvature effects. Implications of the results are assessed for the effects of generic advertising on market prices.

2. Past Approaches

To investigate the impact of advertising on demand, Brester and Schroeder (1995) summarized three approaches used in the past. The first approach is to assume that advertising changes consumer preferences, yet results in a parallel shift in consumer' demand. This intuition motivates introduction of advertising into a linear demand function as a dummy variable as a means of estimating the shift effect of advertising. This approach can be implemented using cross-sectional data across markets with and without advertising. A second approach incorporates advertising expenditure as a measure of advertising intensity into the demand function. In this case, the demand is conceptualized as determined by preferences that are continuous in advertising intensity, e.g. Kinnucan and Belleza (1991), Kaiser (1997), as well as Funk et al. (1977). A third approach is to allow advertising intensity to more generally affect demand, perhaps changing its price elasticity. Brester and Schroeder (1995) consider this possibility by estimating the effects of both brand and generic advertising on consumer demand for beef, pork, and poultry. Advertising expenditures were incorporated into the model as a demand shifter and scaling prices and total product expenditure. They find that the effect of generic adverting on advertising elasticity is negligible, whereas the brand advertising is found to have positive effects on the consumption on three meats. Crespi and Sexton (2001) evaluated the

economic impacts of advertising expenditures funded under the almond marketing order. Their results showed that the correlation of industry promotion and demand was positive and statistically significant. In addition, the price elasticity of demand for current time series from 1980 to 1998 is considerably lower. They offer as explanation the observation that greater production and consumption in recent years may have moved the almond industry down along a fairly stable linear demand curve into the more inelastic ranges of the curve. However, none of these past studies considered the implications of advertising on price effects.

Kinnucan and Belleza (1995) use a displacement [1] method to investigate the price and quantity effects of a dairy advertising program in Canada. The calculate estimated impacts of dairy product advertising on demand for various dairy products based on elasticities for retail demand, wholesale supply, and retail-wholesale price transmission. Results indicate that the relative impacts of increased fluid milk and butter advertising depend critically on the supply elasticity. In addition, since the results show the increasing marginal returns of advertising on fluid milk and butter, they suggest that generic advertising for milk and butter is not at an optimal investment level.

Various hypotheses have been used to motivate specifications that allow the price elasticity of demand to change with advertising. Kinnucan and Venkateswaran (1994) propose a structural heterogeneity hypothesis to motivate generic advertising responses that vary over time. The structural heterogeneity hypothesis suggests that a dollar spent on advertising today may elicit a different response than for the same dollar spent tomorrow. This follows simply from the observation that the nature of advertising messages, target audiences, and managerial ability are

[1] An displacement model is combined with econometric estimates of key model parameters to identify the impacts on prices and quantity.

not static but vary over time. Their results suggest that advertising elasticities declined more or less monotonically over a sample period in which advertising increased.

In this paper, we focus on the impacts of advertising on the demand elasticity though we extend past work by examining evidence of its variation over time due to both changes in the price level and in the intensity of advertising. This paper extends the Brester and Schroeder's (1995) approach to allow for a curvature effect on demand of generic advertising. This paper presents a new hypothesis derived from a view that preferences are held over quality flows, not product quantities; that consumption is affected by habit persistence (see Goddard and Amuah); and that generic advertising reduces information cost for quality flows inducing a change in consumers' preferences in product space. Clearly, this is a substantially different perspective than found in past work.

Given the limited scope of this paper, we present a brief though, hopefully, sufficient motivation for our theory and the main hypotheses implied by it. A brief overview of the effects of generic advertising precedes specification of the empirical model. A description of the data and hypothesis testing procedure follows. The concluding section summarizes the findings and provides suggestions for further research.

3. Reconsideration of the Effects of Generic Advertising

We begin by proposing that the concept of habit persistence is relevant to the understanding of the effects of generic advertising. Goddard and Amuah (1989) use a measure of habit persistence based on past consumption levels as an explanatory variable in the demand function. Their results show that the demand for individual fats and oils is significantly affected by lagged advertising expenditure levels, habit persistence, and a time trend, as well as price and expenditure. The idea of habit persistence, ironically, is often referenced with respect to the "habit", or addiction, of cigarette

smoking, see Becker, 1992. Becker relies on the concept to explain addiction within the context of rational economic behavior. Habit persistence has also drawn attention in other literature, e.g. in the trade and finance literature to explain observed inertia in adjustment of prices to exchange rate changes, see e.g. Obstfeld (1992). In consumer demand theory habit driven behavior has been used to explain continuing trends in consumption or inertia inadjustment to changes in the economic environment (see Lubulwa, 1982; Heien and Durham, 1991; or Adamowicz, 1994). Clearly, the concept would seem appropriate within the context of advertising that is targeted as controlling the image or reputation of a good in the consumer's mind. To see this, define the *consumption flow* as the perhaps unobservable, personal "service" flow generated by "consumption" of a good. That is, it is not the physical chewing, digestion, etc. of a food that is relevant, but the consumption of the quality flow that can be valued by individual preferences. In this sense, quality flow potential of a good can be viewed as a scalar, or vector.

Suppose the consumption flow is not observable until after physical consumption (destruction) of the good. In this situation, the consumer must estimate the quality flow that is likely to result from physical consumption of a good. (We all do this when we check out an apple before we bite into it.) We can conclude that if this is an accurate characterization of the consumption process, then information concerning the potential consumption flows of goods must be collected by rational consumers to form a knowledge base that labels each good with a prior that defines potential consumption flow. Where information is costly to collect, analyze, and synthesize into a consumption flow perception, advertising constitutes an important means for a producer to manage these costs. That is, in the absence of advertising, consumption requires the consumer to pay a market price for the right to consume a good, say p, however, the consumer must also pay the information costs, c, of establishing an estimate of the consumption flow for the good. Advertising

can be viewed as a mechanism for the producer to reduce the information costs for the consumer to achieve an estimate of the consumption quality flow that is consistent with the producer's intent. This perspective on the function of advertising clearly suggests that it may be rational that consumption exhibits inertia in adjustment and appears habitual. The effect of advertising is to reduce the cost of information associated with a particular good and to expand the perceived consumption flow. We argue the effect of generic advertising can be summarized as affecting an outward twist, and possibly a shift in the demand curve.

To state this hypothesis more concretely, consider Figure 1. This presents the traditional hypothesis that advertising (A) shifts the demand curve (D) outward, increasing price at least in the short-run until increased supply is induced through entry of new firms or expansion of capacity. Our thinking is summarized in Figure 2. Here, the effect of advertising is to twist, and possibly shift the demand curve, making it more convex. The implication of this effect is the hypothesis we address empirically. Our characterization is consistent with the traditional view that the demand response to advertising holding price fixed is nonnegative, $\frac{\partial D}{\partial A} \geq 0$. However, our view also motivates the hypothesis that at a particular price, the price responsiveness of demand ($h = \frac{\partial D}{\partial p}$) increases with advertising intensity, $\frac{\partial h}{\partial A} \geq 0$. In our specification, the curvature suggested in Figure 2 would imply the following comparative-statics of the price elasticity:

$$-\frac{\partial D}{\partial p}\Big|_{A'} \leq -\frac{\partial D}{\partial p}\Big|_{A^0} \quad for \quad p\Big|_{A'} \geq p\Big|_{A^0}$$

$$-\frac{\partial D}{\partial p}\Big|_{A'} \geq -\frac{\partial D}{\partial p}\Big|_{A^0} \quad for \quad p\Big|_{A'} \leq p\Big|_{A^0}$$

Finally, with respect to price volatility, it is clear from Figure 2 that an increase in convexity of the demand curve would result in a change in the range of variation of price associated with shifts in supply from $\tilde{S}$ to $\underset{\sim}{S}$. From Figure 2, it is clear that the impact of the demand "twist" on price volatility resultant from stochastic supply would depend on the extent and nature of the twist.

4. Empirical Evidence

To examine the hypotheses motivated in the previous section, we estimate an augmented translog form for the demand function. That is, we begin with a second-order approximation of demand:

$$(1) \qquad \ln Q_{dt} = \ln a + b \ln P_t + l \ln A_t + d \ln P_t \ln A_t + g \ln X_t + \ln e_t,$$

where Q_{dt} is quantity demand, P_t is market price, X_t is a vector of other relevant exogenous determinants of demand such as total meat expenditure, A_t is advertising expenditure, and e_t is the error term. The general form of demand elasticity (e_p^d) can be represented as

$$(2) \qquad e_p^d = \frac{\partial \ln Q_{dt}}{\partial \ln P_t} = b + d \ln A_t.$$

Next, to allow for a change in curvature of demand, we define

$$(3) \qquad d \equiv d_0 - d_1 \ln P_t.$$

rendering an augmented translog functional form:

$$(4) \qquad \ln Q_{dt} = \ln a + b \ln P_t + l \ln A_t + d_0 \ln P_t \ln A_t + d_1 (\ln P_t)^2 \ln A_t + g \ln X_t + \ln e_t$$

Nested within this form, we note that

$$(5) \qquad \begin{aligned} e_p^d &= b, && \text{if} \quad A_t = 0 \\ &= b + d_0 \ln A_t + 2 d_1 \ln P_t \ln A_t, && \text{if} \quad A_t > 0 \end{aligned}$$

Our focus in this paper is to test the effect of generic advertising on demand elasticity based on different prices. Mathematically, it can be expressed as examining the conditionality of the

response of the price elasticity of demand on the price level. That is, $\frac{\partial e_p^d}{\partial \ln A}\Big|_{P_t \lesseqgtr P_{t-1}}$. State differently, the hypothesis is that $e_{p_t}^d \leq e_{p_{t-1}}^d$ when $P_t \geq P_{t-1}$, and by contrast $e_{p_t}^d > e_{p_{t-1}}^d$ when $P_t < P_{t-1}$. Since $\frac{\partial e_p^d}{\partial \ln A}\Big|_{P_t \lesseqgtr P_{t-1}} = d\Big|_{P_t \lesseqgtr P_{t-1}}$, the null hypothesis is $H_0 : d_0 = d_1 = 0$.

Before proceeding with an application, we note that in this preliminary work we suppose that habit persistence is captured by the intercept of the estimated demand function, rather than complicating the specification to explicitly estimate the extent an exact nature of habit persistence.

4. Empirical Implementation and Results

The empirical specification will allow parametric estimation of nonlinear effects of generic advertising. To evaluate this possibility we consider U.S. aggregate demand for beef using generic advertising data collected from quarterly issues of AD $ Summary published by the Leading National Advertisers, Inc. Quarterly data from 1976 through 1996 is used. Per capita beef consumption is the dependent variable. Choice beef retail prices for as price series. Both data series are obtained from *Red Meat Year Book*, USDA.

The model is proposed to examine the price and demand elasticity effects of the generic advertising in beef market is based on a two-stage least square approach. The first stage is to find an instrumental variable for the price series. Two exogenous variables, commercial cattle slaughter and frozen beef stocks in cold storage, are chosen as instruments. The second stage of the proposed demand function is estimated as a translog linear relationship between per capita beef consumption, price series, total advertising expenditure, total per capita meat expenditure, an interactive term of price and advertising, and one consumption equation (3).

Three models are estimated. In terms of statistical fit, all estimated equations are found to be reasonable with respect to R^2. The first model is consistent with our hypotheses, incorporating Equation (3) $d \equiv d_0 - d_1 \ln P_t$ in equation (1). This specification allows the demand elasticity to be responsive to prices.

$$\ln Q_{dt} = \underset{(1.08)}{2.06800} - \underset{(-0.84)}{0.18035}\ln P_t - \underset{(2.07)^*}{1.84352}\ln A_t + \underset{(1.56)}{0.53296}\ln Exp_t - \underset{(-2.15)^*}{0.64776}\ln P_t \ln A_t + \underset{(2.25)^*}{0.05676}(\ln P_t)^2 \ln A_t \quad (6)$$

Equation (6) specifies per capita beef consumption as a function of choice beef retail price, advertising expenditure, and per capita meat expenditure, and two interactive terms of price and advertising. The t-value is reported in parentheses below each estimated coefficient. The results indicate that advertising, rotation effect (d_0), and twist effect (d_1) are significant. To examine the hypothesis $H_0 : d_0 = d_1 = 0$, recall equation (5). If the null hypothesis is accepted, prices have no effect on the demand elasticity. However, the estimates in equation (6) reject this null hypothesis indicating that the current sample is consistent with the alternative hypothesis that the demand elasticity is indeed affected by the prices.

The second model we drop the equation (3) and keep the interactive term of advertising expenditure and price.

$$\ln Q_{dt} = \underset{(2.41)^*}{4.14219} - \underset{(-4.26)^*}{0.56800}\ln P_t - \underset{(-1.68)}{0.15383}\ln A_t + \underset{(1.55)}{0.54268}\ln Exp_t + \underset{(1.68)}{0.02820}\ln P_t \ln A_t \quad (7)$$

The results indicate that only intercept and price are significant. That is, generic advertising has no shift effect and no rotation effect on demand.

Finally, the third model is what could be viewed as the "classical" specification:

$$(8) \qquad \ln Q_{dt} = \underset{(2.20)^*}{3.80339} - \underset{(-4.24)^*}{0.413651}\ln P_t - \underset{(-0.14)}{0.00056}\ln A_t + \underset{(1.16)}{0.401141}\ln Exp_t$$

Equation (8) specifies per capita beef consumption as a function of choice beef retail price, advertising expenditure, and per capita meat expenditure. The results indicate that only intercept and price are significant. That is, generic advertising has no shift effect on demand.

Figure 3 summarizes the results with respect to variation of the estimated demand elasticity with respect to price. Figure 3 shows a clearly negative relationship between log-price and the absolute value of demand elasticity. Thus, as price increases, the magnitude of demand elasticity decreases; by contrast, the magnitude of the demand elasticity increases as price decreases. These results are consistent with a change in curvature of the demand function. Figure 4 represents evidence of variation of the demand elasticity with advertising expenditures.

Figure 4 does not show a clear relationship between log-advertising and the absolute value of demand elasticity. The relationship in Figure 4 is not consistent with a ceteris paribus relationship between the price elasticity and advertising, rather it suggests pairs of advertising and the resulting price elasticity associated with the resulting price and quantity pair. Although we didn't consider the accumulation effect of advertising in our model, according to an increasing trend of the advertising expenditure from the original data, this figure still conveys some information. We interpret this result that the magnitude of demand elasticity is large when advertising is low, when time goes by and advertising continuously increases, the magnitude of demand elasticity becomes smaller. Again, "habit persistent" is confirmed.

5. Practical results: implications and importance

Based on parametric tests, we find that the demand elasticity appears to be affected by the intensity of generic advertising and we examine the implications of this finding for the price of beef. We find generic advertising to enhance price level, while reducing price volatility as the convexity of the demand curve with respect to price is increased. This second result creates a new role for generic advertising in stabilizing prices. The results also suggest that at any point in time, the effects of generic advertising can be decomposed into a shift and "twist" or curvature change. We present this decomposition and note that it implies the existence of a threshold price. At prices above this threshold, generic advertising will decrease the price elasticity of demand, while below this threshold, generic advertising will increase the price elasticity. This result suggests clearly that the demand effects of generic advertising are price dependent. Clearly, the extent of this effect deserves further examination though findings in this paper strongly motivate further study.

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Figure 1: Linear demand function

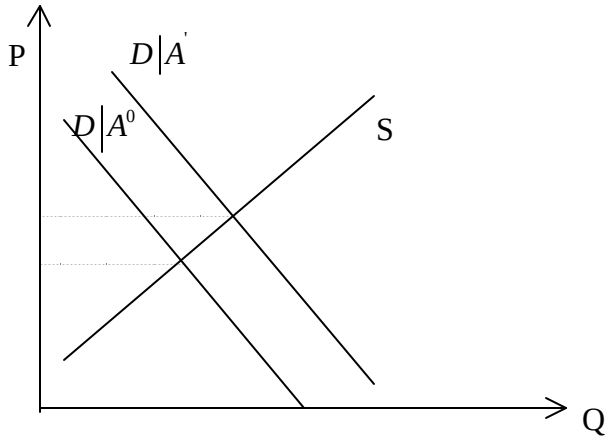

Figure 2: General demand function

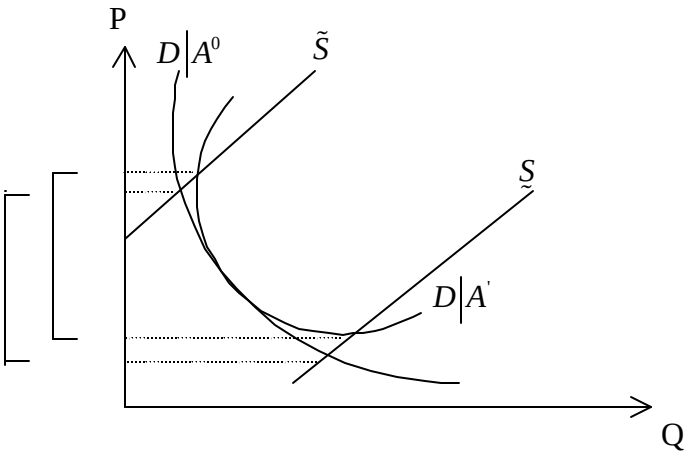

Figure 3: Estimated Demand Elasticity Variation with respect to Prices

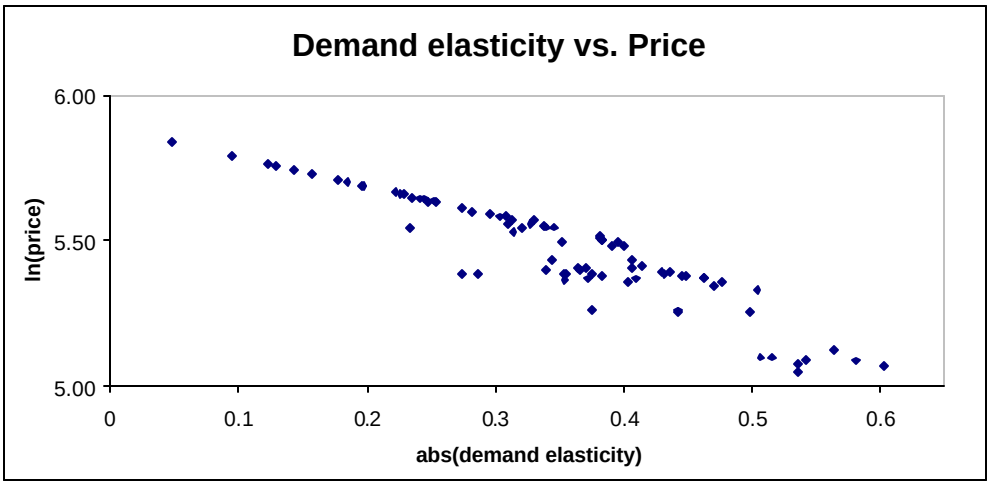

Figure 4: Variation of Demand Elasticity with Advertising Expenditures