Does Generic Advertising Warp Demand Curvature?

Ming-Chin Chin and Robert D. Weaver*

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. To evaluate this possibility we consider U.S. aggregate demand for beef. Quarterly data from 1976 through 1996 is used. Based on parametric tests, we find evidence consistent with convexity in the demand curve for beef with respect to its own price. Further, we find evidence that the demand elasticity and the convexity of demand are affected by the intensity of generic advertising.

***Keywords**: Generic Advertising, Demand Elasticity, Habit Persistence*

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I、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. As for manufacturers, advertising has been viewed as establishing or enhancing product differentiation and price competition (Kaldor（1950）and Bain（1956）). Two types of advertising have been used in markets. Generic advertising usually applies to agricultural products because of homogeneous attributes, and so is designed to change or reinforce consumer preferences and consumption habits. Brand advertising usually applies to the differentiated products and attempts to highlight a particular brand to encourage consumers to switch their consumption from other substitutes. Traditionally, generic advertising is usually launched by the government or farmer's cooperatives, and the single firm usually is charge of brand advertising.

Evidence in hand suggests that the role of generic advertising deserves further attention. Two types of advertisements produce two different effects in the market. Some of the brand advertising may beneficial to the commodity as a whole, and some of generic advertising may boost a particular brand. Many empirical studies provide different results. Brester and Schroeder (1995) concluded that generic advertising did not lead to a significant parallel shift 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 individual demand for each of a set of fats and oils products (butter, margarine, shortening, and vegetable oils) was significantly and positively affected by lagged generic advertising expenditures, whereas aggregate demand for the fats

and oils category 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 with respect to retail flower outlets and dairy markets. In brief, past 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. Implications of the results are assessed for the effects of generic advertising on market prices. The objective and major contribution of this paper is to provide an appropriate method to exam the effectiveness of advertising.

II、Past Approaches

To investigate the impact of advertising on demand, Brester and Schroeder (1995) summarized three approaches used in the past. First, advertising has been hypothesized to affect changes in consumer preferences. That in turn has been hypothesized to result in a parallel shift in consumer demand. Empirically, a binary indicator of advertising has been introduced into a linear demand function to estimate the extent of any shift in demand. Ward and Lambert (1993) estimated the economic impact of U.S. beef checkoff efforts on demand using a binary indicator of advertising and found evidence of that generic advertising has substantially shifted beef demand outward. A second approach incorporates advertising expenditure as a measure of advertising intensity into the demand function. In this case, 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 expenditures on consumer demand for beef, pork, and poultry. Advertising expenditures were incorporated

in the form of a stock of investment into a Rotterdam model with scaling. The stock variable was obtained using a procedure proposed by Cox (1992). They find that the effect of generic advertising on price elasticity of demand is negligible, whereas the brand advertising is found to have positive effects on the consumption of three meats. Crespi and Sexton (2001) evaluated the economic impacts of advertising expenditures funded under the almond marketing order. They found that the correlation of industry promotion and demand was positive and statistically significant. In addition, they found that the price elasticity of demand for the period from 1980 to 1998 was considerably smaller than for the period from 1962 to 1998. They offer as explanation the observation that greater production and consumption in recent years may have moved the almond industry downward along a fairly stable linear demand curve into the more inelastic ranges of the curve.

With respect to the implications of advertising for price, Kinnucan and Belleza (1995) use a displacement model to investigate the price and quantity effects of a dairy advertising program in Canada. Their results indicate that the relative impacts of increased fluid milk and butter advertising depend critically on the price elasticity of supply. Brown, Lee and Spreen (1996) examined the impacts of generic advertising on demand and prices for the US orange juice market. Their results suggest that international trade because of spillover effect may substantially limit the impacts of advertising on price. Suzuki and Kaiser (1997) examined the impacts of generic advertising on the US dairy industry. Their results indicated positive price and quantity responses to generic advertising.

Various rationales have been used to motivate specifications that imply the price elasticity of demand changes 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 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 reconsiders the Brester and Schroeder (1995) notion and allows generic advertising to affect the curvature of demand. Given the limited focus of this paper, we present a brief though 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.

III、Consideration of the Effects of Generic Advertising

Habit persistence has been introduced to explain observations that current demand is conditioned on past consumption. Becker (1992) relies on the concept of habit persistence to explain addiction within the context of rational economic behavior. 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). Ferson and Constantinides (1991) noted that habit persistence in consumption preferences implies that resulting indirect utility and expenditure functions are not intertemporally separable. They specify habit persistence such that current minimum subsistence demand is a weighted sum of the past consumption. 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).

The possibility that the effects of generic advertising may be conditioned by

habit persistence has been recognized by Goddard and Amuah (1989) who use past consumption levels as a measure of habit persistence. They find evidence 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. Clearly, the concept would seem appropriate within the context of advertising that is targeted at changing 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 conclude that if this is an accurate characterization of the consumption process, then information concerning the potential quality of consumption flow of a good must be collected by rational consumers. Based on collected information, the quality of the good is estimated resulting in its classification or labeling according to estimated quality. Where information is costly to collect, analyze, and synthesize, advertising constitutes an important means for producers to manage the cost of information necessary to accurately classify or estimate the quality of their good. Consumption requires the consumer to pay a full consumption price, p, consisting of the market price for the right to consume a good, say P, however, the consumer must also pay information access costs, c, to establish their estimate of the quality flow associated with physical consumption of the good. This perspective on the function of advertising clearly suggests that it may be rational for consumption to exhibit inertia in adjustment such that it appears habitual. The effect of advertising is to reduce the cost of information, c, reducing the associated full consumption price of the good. Where demand is monotonically positive in the full consumption price, this perspective clarifies how advertising increases consumption for rational consumers.

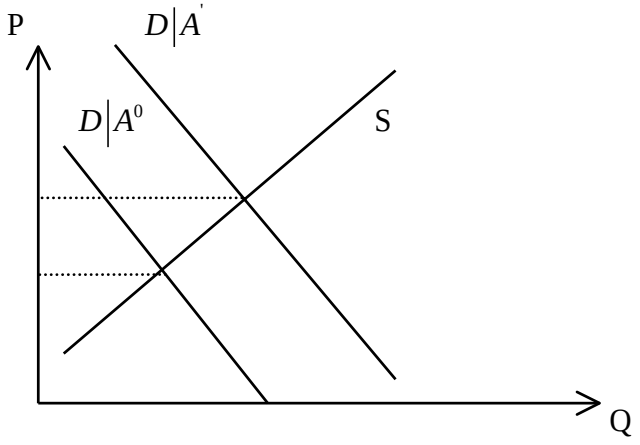

Figure 1: Linear demand function

In this paper, we extend this logic to argue that the effect of generic advertising on demand includes both a shift as well as a possible change in curvature of the demand curve. To state this hypothesis more concretely, Figure 1 presents the traditional hypothesis that advertising increased from A^0 to A' shifts the demand curve outward from $D|A^0$ to $D|A'$, increasing price at least in the short-run until increased supply is induced through entry of new firms or expansion of capacity of existing firms. We argue this occurs because at some initial level of advertising, A^0, product information costs are $c(A^0)$. By tradition, demand is graphed with respect to market price, P, not the full consumption price, p. In this case, the position of the demand curve is conditional on product information costs are $c(A^0)$. However, only in an unusual case would the demand curve be only shifted by advertising. This proposition is clarified by the following notation.

Suppose that product information cost is in general conditioned by market price as well as advertising, i.e. $c = c(P, A^0)$. Define a general nonlinear demand function, $Q_d = Q_d(p) = Q_d(P + c(P, A)) = q_d(P.A)$. Thus, even when demand $Q_d(p)$ is linear in full product price, it is reasonable to suppose it is nonlinear in market price, P. The nature of this possibility and our hypothesis is summarized in Figure 2. We suggest that in the presence of habit persistence, advertising may be viewed as increasing product loyalty, decreasing price response to price increases and increasing price response to price decreases. This effect is summarized as increased convexity in the demand curve.

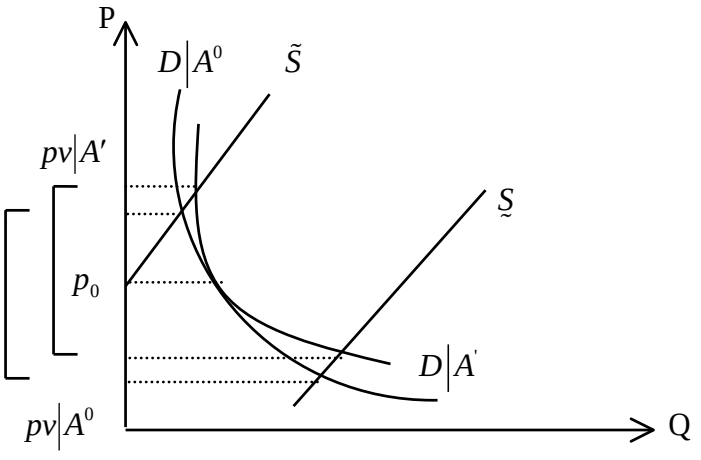

Figure 2: General demand function

Our characterization is consistent with the traditional view that the demand response to advertising holding price fixed is nonnegative. However, our hypothesis is that price responsiveness is affected by advertising. In particular, when demand is convex in market price, price responsiveness is less at prices above than at prices below the current price[1]. Convexity and this implication are consistent with habit persistence derived from product loyalty and nonsatiation. Our hypothesis is that advertising accentuates convexity, warping the demand curve, see Figure 2.

Succinctly, our hypothesis can be showed as follows.

$$\left|\frac{\partial q_d}{\partial p}\right|_{p',A'} \leq \left|\frac{\partial q_d}{\partial p}\right|_{p',A^0} \qquad for \qquad p' > p_0$$

$$\left|\frac{\partial q_d}{\partial p}\right|_{p',A'} \geq \left|\frac{\partial q_d}{\partial p}\right|_{p',A^0} \qquad for \qquad p' < p_0$$

Again, $A^0 \geq 0$ is the initial level of advertising. Increased advertising, $A' > A^0$, induces demand response is price dependent. The implications of the hypothesized conditions are several. First, in the presence of demand curve

convexity the hypothesis implies that advertising renders demand less price elastic at prices above the current level. Strategically, this possibility would imply that advertising reduces the demand response at higher prices. Second, the hypothesized conditions have implications for price volatility. As is clear from Figure 2, an increase in convexity of the demand curve would result in a change in the range of variation of price, pv, associated with random shifts in supply. From Figure 2, $pv|A^{0}$ and $pv|A'$ are the possible price range (price volatility) with respect to advertising levels A^{0} and A', respectively. It is clear that the implications for price volatility of an increase in demand convexity will depend on the extent and nature of the change. From Figure 2, it is obvious that advertising shifts up the price range from $pv|A^{0}$ to $pv|A'$, so we claim that advertising increases prices. As for price volatility, Figure 2 clarifies that no guaranteed theoretical conclusion can be drawn.

Ⅳ、Empirical Evidence

To examine the hypothesis motivated in the previous section, we estimate an augmented translog form for the demand function. To motivate this functional form, we note that our hypothesis can be equivalently stated in terms of demand response to advertising. From that perspective, the hypothesis states simply that demand response to advertising is price dependent to a second-order. Writing demand in log-linear form, the hypothesis is simply stated as follows:

$$\ln q_{dt} = \alpha_0 + \alpha_1 \ln P_t + \alpha_2 \ln A_t + \alpha_3 \ln X_t + \varepsilon_t \tag{1}$$

where we allow for a second-order price dependence of the advertising effect by specifying

$$\alpha_2(P_t) = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln P_t^2 \tag{2}$$

By substitution, the estimated model is:

$$\begin{aligned}\ln q_{dt} &= \alpha_0 + \alpha_1 \ln P_t + (\beta_0 + \beta_1 \ln P_t + \beta_2 \ln P_t^2) \ln A_t + \alpha_3 \ln X_t + \varepsilon_t \\ &= \alpha_0 + \alpha_1 \ln P_t + \beta_0 \ln A_t + \beta_1 \ln P_t \ln A_t + \beta_2 \ln P_t^2 \ln A_t + \alpha_3 \ln X_t + \varepsilon_t\end{aligned} \tag{3}$$

where q_{dt} is quantity demanded, 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 ε_t is a stochastic i.i.d. error. Our specification of the price elasticity of demand (η_p^d) can be represented as:

$$\begin{aligned}\eta_p^d &= \frac{\partial \ln q_{dt}}{\partial \ln P_t} = \alpha_1 \quad if \qquad A_t = 0 \\ &= \alpha_1 + \beta_1 \ln A_t + 2\beta_2 \ln P_t \ln A_t \qquad if \qquad A_t > 0\end{aligned} \tag{4}$$

We propose to test our hypothesis using the joint parametric restriction $\beta_1 = 0, \beta_2 = 0$.

V、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 are used as the price series. Both data series are obtained from Red Meat Year Book, USDA. Brester and Schroeder (1995) used U.S. quarterly price indices from 1970 to 1994 taken from U.S.D.A.'s Livestock Situation and Outlook Reports. Kinnucan et al. (1997) used retail quarterly prices from 1976 through 1993 based on similar U.S.D.A. data. Brester and Schroeder (1995) used generic and brand advertising expenditures in a study on the beef, pork, and poultry market. Kaiser (1997) used generic advertising in his study of the impacts of generic advertising on dairy markets for fluid milk, cheese, butter, and frozen products. Kinnucan et al.

(1997) used generic advertising expenditures per capita in a study of meat demand.

To avoid possible simultaneity bias, the demand function is estimated using two-stage least squares. In the first stage, two exogenous variables, commercial cattle slaughter and frozen beef stocks in cold storage, are used as instruments. Three models were estimated and are reported in Table 1. Statistical fit of each was acceptable based on R^2.

Table 1. Estimated Beef Demand

Dependent Variable	*Independent Variables*						*Demand Elasticity*	R^2	*MSE*
$\ln q_{dt}$	constant	$\ln P_t$	$\ln A_t$	$\ln X_t$	$\ln P_t \ln A_t$	$(\ln P_t)^2 \ln A_t$			
Model 1	2.06800	-0.18035	-1.84352	0.53296	-0.64776	0.05676	-0.34841	0.8989	0.03527
	(1.08)	(-0.84)	(2.07)*	(1.56)	(-2.15)*	(2.25)*			
Model 2	4.14219	-0.56800	-0.15383	0.54268	0.02820		-0.37768	0.8922	0.03619
	(2.41)*	(-4.26)*	(-1.68)	(1.55)	(1.68)				
Model 3	3.80338	-0.41365	0.00407	0.34476			-0.41365	0.8883	0.03661
	(2.20)*	(-4.24)*	(-0.14)	(1.16)					

Note: Numbers in parentheses are t-values for the parameter estimates and MSE is the mean of square error. The estimated demand elasticity was evaluated at the mean of the sample data.

The first model is consistent with our hypotheses, estimating equation (3). This specification allows the demand elasticity to be responsive to prices. The results are consistent with the hypothesis that advertising both shifts, $\hat{\beta}_1 \neq 0$, and increases the convexity of the demand curve, $\hat{\beta}_2 \neq 0$. We jointly test this hypothesis, finding an estimated F-statistic is 135.20 that strongly rejects the joint hypothesis, $\hat{\beta}_1 = \hat{\beta}_2 = 0$, confirming that the sample evidence is consistent with our hypothesis that advertising effects are conditional on market price level to a second-order. The second model reported in Table 1 is incorporates the Brester and Schroeder hypothesis that advertising induces a change in price

elasticity, though the extent of that change is not price dependent. The results reported in Table 1 emphasize that functional specification is crucial.

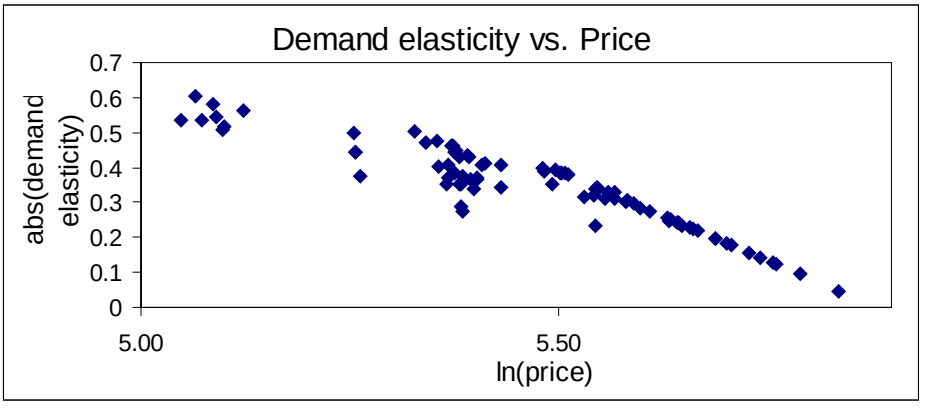

Figure 3: Estimated Demand Elasticity Variation with respect to Prices

Comparison of model 1 and 2 indicate that parameter estimates are not robust to exclusion of the second-order price effect on the demand response to advertising. Estimates of model 2 are consistent with Brester and Schroeder's finding that generic advertising does not shift the demand function and has no effect on the elasticity of demand. However, results from model 1 that incorporates the second-order price effect reject the specification of model 2, i.e. we find results that are consistent with the conclusion that $\hat{\beta}_2 \neq 0$. The third model reported in Table 1 is what could be viewed as the "traditional" specification where only a linear shift is allowed. Again, under this restricted specification ($\hat{\beta}_1 = \hat{\beta}_2 = 0$) results indicate that only intercept and price are significant, and that generic advertising has no effect on demand. Together, these results suggest that functional specification of the demand curve deserves further attention in research that considers the effects of advertising on demand. Based on our sample results, we find strong evidence that the effect of advertising both shifts demand and changes the curvature of the demand function. These results are consistent with our suggestion that advertising impacts the cost of information altering the full consumption price paid by consumers.

Figure 3 summarizes the results with respect to variation of the estimated demand elasticity with respect to price. Theoretically, this relationship is indeterminate, however, Figure 3 shows

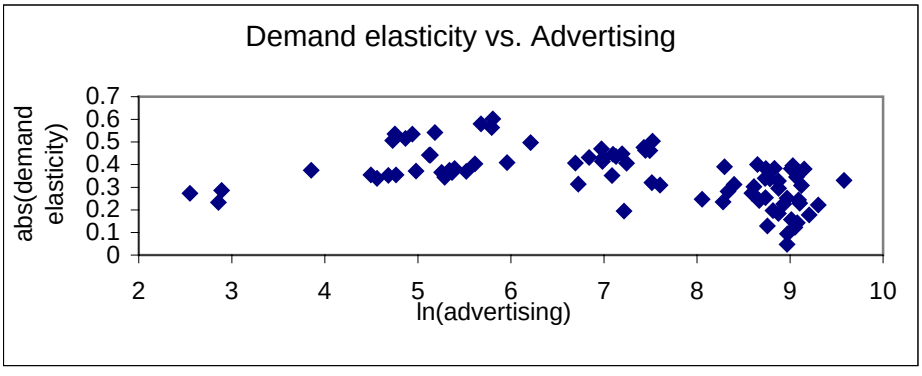

Figure 4: Variation of Demand Elasticity with Advertising Expenditures

that based on our estimates a clearly negative relationship exists between observed values for the logarithm of price and estimates of the absolute value of demand elasticity. Based on our estimates,

$$\eta_p^d \equiv \hat{\alpha}_1 + \hat{\beta}_1 \ln A_t + 2\hat{\beta}_2 \ln P_t \ln A_t = -0.18 - 0.65 \ln A_t + 2(0.06) \ln P_t \ln A_t$$

As is clear from Figure 3, based on our estimates, 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 convexity of the demand function with respect to price. The relationship between advertising and the price elasticity of demand is also indeterminate at a theoretical level. Figure 4 presents evidence of variation of the demand elasticity with advertising expenditures based on our estimates. No clear relationship is found between advertising and the absolute value of demand elasticity.

Ⅵ、Practical implications and conclusions

Based on parametric tests, we find evidence consistent with convexity in the demand curve for beef with respect to its own price. Further, we find evidence that the demand elasticity and the convexity of demand are affected by the intensity of generic advertising. These results have several implications. First, we find evidence that is consistent with generic advertising enhancing price level through a shift effect. Second, our evidence with respect to generic advertising increasing convexity of the demand curve with respect to price is consistent with the conclusion that generic advertising of beef has affected price volatility. When the price is said to be more volatile, it means that the farmers may endure higher economic costs. However, in the absence of supply information, the direction of change in price volatility is not determinable. Nonetheless, evidence of such a change in convexity motivates further research to estimate these effects and to reconsider the implications of generic advertising for the stability of prices. The results provide evidence that at any point in time, the effects of generic advertising can be decomposed into a shift and a “twist” or curvature change, and in turn, the effectiveness of advertising can be more accurately evaluated.

Endnotes

1. Note this condition does not imply asymmetry in response. In fact, locally around a particular price, price response remains symmetric.

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Does Generic Advertising Warp Demand Curvature?

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本文從理論與實證分析的角度探討一般性廣告對需求曲線的影響，進而推論當市場清結時，均衡價格與數量即可得知。有別於之前文獻只討論線性需求函數，本文著重廣告對非線性需求函數的影響。我們假設廣告會造成非線性需求曲線的曲度擴大，即當市場價格上升時，廣告會緩和消費需求的減少；反之當市場價格下降時，廣告會加強消費需求的增加。實證分析以美國牛肉市場爲例，期間從 1976 至 1996 年。 結果發現一般性廣告對美國牛肉市場需求曲線的影響符合本文假設，即需求曲線的曲度增加。此外，本文並建議若配合市場供給可模擬均衡價量，如此將可更完整與正確地評估廣告的效率性。

關鍵詞：一般性廣告，品牌性廣告，價格需求彈性，價格波動性

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