# How Does Advertising Affect Market Performance? The Case of Generic Advertising

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February 23, 2011

**Abstract**

-.01cm-.01cm In this paper, we propose a novel approach to estimating the effect of advertising on market performance that relies on the preferences of firms participating in generic advertising programs. Generic advertising campaigns provide a unique window to observe advertising effects on market performance, because rotations in market demand systematically redistribute advertising rents among firms according to observable characteristics on producer size. We examine producer attitudes towards generic advertising in the "Beef. It's What's for Dinner" campaign of the U.S. Beef Checkoff program, the subject of the recent and controversial Supreme Court ruling on generic advertising as a form of government speech. We find the likelihood producers favor an expansion of the advertising program increases in their operating scale. This finding is consistent with an advertising campaign that has led to a counterclockwise rotation of market demand and a commensurate increase in market performance in the U.S. Beef market.

JEL classification: L1, M37
Key words: Advertising, Oligopoly

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# 1 Introduction

A long-standing debate in the economics of advertising is the effect of advertising on market performance.[1] One school of thought, articulated in the contributions of Kaldor (1950) and Bain (1956), advocates that advertising serves primarily a persuasive role. According to this view, advertising increases product differentiation and deters entry by contributing recognition and prestige to advertised goods, which leads to clockwise rotations of demand that inflate the market power of firms. A second school of thought, formalized by Ozga (1960), Stigler (1961), Telser (1964) and Nelson (1970, 1974), points to the important role of advertising in providing price and product quality information. Informative advertising reduces the costs associated with consumer search and facilitates substitution possibilities between products, resulting in counterclockwise rotations of demand that narrow price-cost margins and improve market performance.

In this paper we derive inferences on how advertising alters market performance using a novel approach that relies on differences in advertising returns to individual producers in generic advertising programs. As Johnson and Myatt (2006) demonstrate, informative advertising results in a clockwise (counterclockwise) rotation of demand when information increases (decreases) the dispersion of consumers' valuations in the market. The methods we develop here make use of the fact that changes in the distribution of consumers' valuations also alter the distribution of rents to producers who share a common generic advertising message. This outcome offers the potential to derive inferences on the connection between advertising and market performance by observing changes in the distribution of rents to individual producers in generic advertising programs.

We frame our analysis around a homogeneous product oligopoly market with asymmetric factor endowments among firms, and propel our study by formulating a few simple observations on how rotation effects in market demand resulting from collective advertising efforts redistribute rents among producers in the market. Specif-

[1] For an excellent review, see Bagwell (2005).

ically, we consider generic advertising programs funded through per-unit levies on output and show that advertising messages that result in clockwise (counterclockwise) rotations of market demand allocate a disproportionate share of advertising rents to producers with smaller (larger) factor endowments. This redistribution of rents between firms with different factor endowments who participate in collective advertising programs therefore provides a novel lens to examine the effect of advertising on market performance.

We apply our model to the generic advertising campaign administered by the Cattleman's Beef Research and Promotion Board ("the Beef Board"). The "Beef. It's what's for dinner!" generic advertising campaign of the Beef Board represents an ideal market to study for several reasons. First, with an annual checkoff collection of $80 million per year, the Beef Board is one of the largest federal marketing orders in the U.S. Second, the data we utilize for our approach, which is derived from a recent USDA/Gallup survey on the preferences of beef producers for generic advertising, is characterized by considerable variation in the operating scale of individual producers, with 12.7 percent of ranchers running operations of less than 20 head of cattle and 10.2 percent of operations in excess of 250 head. Third, beef is a relatively homogeneous product. Over 80 percent of beef sold in the U.S. is non-branded, which makes the generic advertising objective of the Beef Board more transparent to members relative to the activities of other marketing boards, for instance dairy products. Finally, participation in the generic advertising program of the Beef Board, which requires a $1 per head "checkoff" fee on all sales or importation of cattle, is mandatory for all producers marketing beef in the U.S. The mandatory nature of the program mitigates selection bias in our examination of producer preferences underneath the umbrella of a collective advertising program.

We follow Becker and Murphy (1993) in viewing advertising as a complementary product to advertised goods. This "complementary view" is sufficiently general to allow advertising to provide private consumption values (e.g., advertisements in the Yellow Pages), public good values (e.g., "social status" emerging in equilibrium

through an element of collective persuasion), or joint consumption value with media goods (e.g., advertising bundled and "sold" together with television programming).[2] Emerging from this view is the sensible conclusion that understanding the welfare effects of advertising requires looking at advertising markets in addition to the markets for advertised goods. Nevertheless, it is clear that encompassing a complementary advertising "good" in individual utility functions does little to resolve how advertising alters the market performance of advertised goods.

There are well-known empirical challenges to measuring the degree of complementarity between goods in individual utility functions containing an arbitrary collection of goods. Take for example Samuelson's (1974) discussion of coffee, tea, and cream. Coffee and tea are substitutes, and both coffee and tea are complementary to cream. If cream is "more complementary" to tea than to coffee –in the sense that consumers use more cream in a cup of tea than they use in a cup of coffee– then a rise in the price of coffee that causes consumers to drink less coffee and more tea can lead to a rise in cream sales. In the case of complementarity between advertising and advertised goods, moreover, the link between advertising and market performance is further complicated by the need to address the higher-order effect of advertising on the dispersion of consumers' valuations.

Our approach overcomes some of the objections to earlier studies of the impact of advertising on the market performance of advertised goods. Following Bain (1956) and Comanor and Wilson (1967, 1974), a large literature has developed that seeks to empirically identify the linkage between advertising and market performance in market data; however, measurement and endogeneity issues confound the interpretation of these results. Changes in demand over time can be driven by a number of factors unrelated to the advertising expenditure of a given firm or industry. Current advertising and sales levels can also affect future demand, as would be the case when "social status" is durable or when temporal consumption levels lead to habit formation, and this requires specifying a distributed lag structure (Clarke 1976; Er-

[2]This view represents a fundamental departure from Kaldor (1950), who regarded advertising as a non-priced commodity sold jointly with advertised goods.

dem and Keane 1996; Ackerberg 2001). Moreover, advertising firms may be attracted to industries with inelastic demand conditions, and multi-product retailers may use advertised brands as loss-leaders to facilitate the sales of related retail goods. Such empirical complications may explain the conflicting findings of studies that estimate the effect of advertising on the price elasticity of demand.[3]

Experimental evidence on the effect of advertising on market performance is also mixed. Natural experiments, for instance Benham's (1972) well-known study on advertising bans in the eyeglass market and the related studies by Cady (1976) and Kwoka (1984), generally find prices to be lower in regions allowing advertising relative to regions that impose advertising bans.[4] In contrast, the general outcome of laboratory and field experiments, for instance the interesting "split cable" TV field experiment by Krishnamurthi and Raj (1985), is that adverting decreases the elasticity of demand (Kaul and Wittink 1995).[5]

We organize the remainder of the paper as follows. In the following section, we provide some background on commodity checkoff programs and the generic beef advertising campaign that frames our study. In Section 3, we formulate a model that links changes in the dispersion of consumers' valuations to changes in the distribution of rents among individual producers in a generic advertising program. In Section 4, we derive implications of the model for producer preferences towards expanding generic advertising in the Beef Checkoff program. Section 5 describes our empirical approach and presents our estimation results.

[3]For a recent review see Erdem, Keane and Sun (2008).

[4]An objection to these studies is that they do not achieve randomization when advertising bans in political jurisdictions are not exogenous to prices. A recent study by Milyo and Waldfogel (1999) remedies this problem by using longitudinal data on liquor products in Rhode Island and Massachusetts that extends over the period in which the Supreme Court overturned Rhode Island's ban on liquor price advertising; however, they find the lifting of the advertising ban to have no significant effect on prices.

[5]For the case of laboratory experiments, recent evidence suggests that lab respondents may express systematically higher willingness to pay values than actual market participants (List 2006).

# 2 Background

Virtually every agricultural commodity operates some type of advertising and promotion program that relies on fees levied on the sales of individual producers. Familiar advertising messages such as 'Got Milk?' 'Pork. The Other White Meat,' 'Cotton: The Fabric of Our Lives,' and 'Beef. It's What's for Dinner,' are funded by various commodity boards through an institutional structure referred to as commodity checkoff programs. The funds collected through checkoff programs are used primarily to expand demand (both domestic and foreign) through generic advertising efforts.

The earliest forms of commodity checkoff programs were based on voluntary contributions. These early programs suffered from free-riding problems, and pressure among industry groups led to the formation of State- and Federally-mandated checkoff fees under Agricultural Marketing Agreement Act of 1937. The U.S. Department of Agriculture currently operates 17 generic advertising programs for agricultural commodities and has at least some degree of oversight for 35 other federal marketing orders. The Federal auspice for generic beef advertising in the U.S. was formalized by the Beef Promotion and Research Act of 1985, which mandated a $1 per head checkoff fee levied on all sales or importation of cattle to fund promotional activities for beef under a Federally-appointed Beef Board. The beef marketing order was established on a temporary basis in 1986, subject to a referendum among beef producers on whether to make it permanent, which was ratified in 1988 with a 79 percent majority. Since the inception of the Beef Board, more than $1 billion has been collected through the checkoff, a large fraction of which has been spent on generic advertising in the "Beef. It's What's for Dinner!" campaign.

Beginning in the late 1980s, individual producers in various commodity checkoff groups constitutionally challenged generic advertising programs on the basis that mandatory checkoffs violate producers' First Amendment right to refuse to pay for expression if they object to its content. In 1997, the Supreme Court ruled that a federally mandated checkoff program for California tree fruits was constitutional, because it was part of a broader regulatory structure for commodity marketing that

already constrained their marketing autonomy.[6] In November of 1999, the Sixth Circuit Court of Appeals ruled in United Foods that the Mushroom Promotion Act of 1990 was unconstitutional, because the Mushroom Act did not contain the elements of broader, collective regulation that the Supreme Court used to uphold *Glickman*.[7] On appeal, the U.S. Supreme Court upheld this ruling in 2001, rendering the opinion that mandatory assessments violate the First Amendment under circumstances where generic advertising is the primary object of the regulatory scheme.[8]

Following the *United Foods* ruling, the Beef Act was challenged on First Amendment grounds. In 2001, the U.S. trial court ruled the Beef checkoff program to be unconstitutional, because, as in *United Foods*, the generic advertising messages were not incidental to a larger regulatory structure. This decision was affirmed by the U.S. Court of Appeals, but was subsequently overturned by the Supreme Court on the grounds that advertising messages funded by the beef checkoff program were not artifacts of private speech at all, but instead represented a form of government speech, which as such is not encompassed by First Amendment rights.[9] The majority ruling of the Court was based on the simple fact that generic beef advertising campaigns are run by the Beef Board's Operating Committee, half of whose members are appointed by the Secretary of Agriculture and all of whom are subject to removal by the Secretary. Hence, the "Beef. It's What's for Dinner!" promotional campaign was determined to be effectively under the control of the Federal Government.

In a dissenting opinion, Justice Souter (joined by Justices Stevens and Kennedy) rejected the notion that generic advertising by an agricultural marketing board qualifies as government speech. While recognizing the legitimacy of government to compel speech for which individual taxpayers might disagree, Justice Souter argued that government speech must also abide by the checks and balances of the political process. In particular, Justice Souter pointedly observed that "(d)emocracy...ensures that

[6] *Glickman v. Wileman Brothers & Elliott, Inc.* (521 U.S. 457 (1997)).

[7] *United Foods, Inc. v. USDA*, 197 F.3d 221 (6th Cir. 1999).

[8] *United States v. United Foods, Inc.* (533 U.S. 405 (2001), at 411-412).

[9] *Livestock Marketing Association (LMA) v. USDA*, 335 F.3d 711 (8th Cir. 2003)) and *Johanns et al. v. LMA* (544 U.S. 550 2005), respectively.

government is not untouchable when its speech rubs against the First Amendment interests of those who object to supporting it; if enough voters disagree with what government says, the next election will cancel the message."

Following the Supreme Court ruling, Harvard Law School professor and attorney Laurence Tribe, who argued the case challenging the Beef checkoff, stated that the ruling was likely to have long-lingering legal ramifications regarding the political accountability of government speech. At the crux of this issue is the implied regulatory oversight by the Federal Government over the content of generic advertising programs and the commensurate social welfare implications of government speech. Government speech presumes to stand in the public interest, and this highlights the importance of identifying the linkage between generic advertising messages and market power for advertised goods.

# 3 The Model

Our model is framed around generic advertising in a homogeneous product oligopoly market. The advertising level is administered by a marketing board that levies a per-unit checkoff fee on the output of members in the program. Membership in the program is mandatory and the marketing board uses all checkoff fee revenues to acquire generic advertising messages through forward contracts with a competitive advertising industry. For analytic convenience, we consider advertising contracts that fully dissipate checkoff fee revenues in the market under complete information.[10]

Advertising expenditure is given by $A = \tau Q$, where $\tau$ is the checkoff fee and $Q$ is the market output level. Inverse demand in the market is $P(Q, \tau)$, which is downward-sloping in industry output, $P_Q(Q, \tau) < 0$ and concave in the checkoff rate; $P_\tau(Q, \tau) > 0$, $P_{\tau\tau}(Q, \tau) < 0$. We classify the rotation effect of advertising on demand as follows: $(i)$ $P_{Q\tau}(Q, \tau) = 0$ for a parallel shift; $(ii)$ $P_{Q\tau}(Q, \tau) < 0$ for a clockwise rotation; and $(iii)$ $P_{Q\tau}(Q, \tau) > 0$ for a counterclockwise rotation. The effect of adver-

[10] Some marketing boards allocate a share of revenues from checkoff fees to research and development activities; however, the vast majority of checkoff revenues in agricultural markets is spent on generic advertising and promotion activities (Williams and Capps, 2006).

tising on market demand can then be decomposed into an outward shift and rotation component, where advertising can increase the dispersion of consumers' valuations (leading to a counterclockwise rotation at the equilibrium output level) or decrease the dispersion of consumers' valuations (leading to a clockwise rotation).

The demand rotation effects in our model correspond to changes in the advertising-output ratio, $\tau = A/Q$. This differs from the approach of Telser (1964) and the literature that follows that examines how changes in the advertising-sales ratio affect market performance. Under circumstances in which a generic advertising program collects fees on an ad valorem basis at rate $\alpha$ on sales, $A = \alpha pQ$, rotation effects on demand that arise from changes in $\alpha$ correspond to examining the effect of changes in the advertising-sales ratio on market performance.

The solution concept for the market equilibrium is Nash in quantities. We take the number of firms ($n$) to be exogenous, which reflects the presence of a fixed factor of production, for instance ownership of scarce land assets, of which the firms have asymmetric endowments. Profits persist in the form of rents returned to the fixed factor, and the outcome can approximate competitive market conditions in the usual case where the number of operating firms is large. We refer to the fixed factor as "capital" and denote the capital endowment of firm $i$ by $k_i$,$i = 1, \ldots, n$.

## 3.1 Market Outcome

The total cost to firm $i$ of producing the output level $q_i$ is given by $c^i(q_i, k_i)$. We follow Perry and Porter (1985) and Farrell and Shapiro (1990) in assuming the production cost of firm $i$ to be increasing in output, $c^i_q \equiv \partial c^i(q_i, k_i)/\partial q_i > 0$, and marginal production cost to be decreasing in the firm's endowment, $c^i_{qk} \equiv \partial^2 c^i(q_i, k_i)/\partial q_i \partial k_i < 0$.

Firm $i$ takes the checkoff rate $\tau$ as parametric and selects the output level, $q_i$, to maximize profits, $\pi^i(q_i, k_i, Q, \tau) \equiv p(Q, \tau)q_i - c^i(q_i, k_i) - \tau q_i$, given the output levels selected by his rivals. The first-order condition for firm $i$ is

$$\pi^i_i \equiv p(Q, \tau) + q_i p_Q(Q, \tau) - c^i_q(q_i, k_i) - \tau = 0, \ i = 1, \ldots, n. \tag{1}$$

Letting $\tilde{k} \equiv (k_1, ..., k_n)$ denote the industry-wide vector of capital stocks, the Nash equilibrium is a vector of quantities, $\tilde{q}^*(\tau, \tilde{k}) = (q_1^*(\tau, \tilde{k}), ..., q_n^*(\tau, \tilde{k}))$ that satisfies equation (1) for each of the $n$ firms.[11]

We employ the standard existence and stability conditions (see Vives 1999, pp 96-97),

$$\theta_i \equiv p_Q(Q, \tau) + q_i p_{QQ}(Q, \tau) < 0, \ i = 1, \ldots, n, \tag{2}$$

$$\bar{\omega}_i \equiv c_{qq}^i(q_i, k_i) + p_Q(Q, \tau) > 0, \ i = 1, \ldots, n. \tag{3}$$

In addition, we denote (without restriction) the effect of a change in the checkoff fee on the marginal revenue of firm $i$ by

$$\gamma_i \equiv p_\tau(Q, \tau) + q_i P_{Q\tau}(Q, \tau) - 1, \ i = 1, \ldots, n. \tag{4}$$

Notice that advertising messages that involve only level effects on market demand, $p_{Q\tau}(Q, \tau) = 0$, do not lead to firm-specific changes in marginal revenue. Level effects on market demand uniformly raise marginal revenue for all firms. In contrast, advertising messages that create both level effects and rotation effects on market demand raise marginal revenue by more for firms with large output levels than for those with smaller output levels when $p_{Q\tau}(Q, \tau) > 0$, and lower marginal revenue disproportionately for firms with large output level when $p_{Q\tau}(Q, \tau) < 0$.

Making use of conditions (1)-(4), the effect of an increase in the checkoff rate on individual and aggregate output levels can be examined by totally differentiating equation (1). Doing so yields

$$\theta_i dQ - \bar{\omega}_i dq_i + \gamma_i d\tau = 0.$$

Rearranging this equation, the change in output for firm $i$ is given by

$$dq_i = -\lambda_i dQ + \delta_i d\tau. \tag{5}$$

where $\lambda_i = -(\theta_i/\bar{\omega}_i)$ and $\delta_i = \gamma_i/\bar{\omega}_i$.

[11] Notice that it follows from this condition that the equilibrium level of output is larger for firms with relatively highly levels of capitalization; that is, $q_i^* > q_j^*$ if and only if $k_i > k_j$.

The distribution of $\lambda_i$'s and $\delta_i$'s in the industry are critical. $\lambda_i$ measures firm $i$'s equilibrium output responsiveness to changes in the market price that occur through movements along the demand curve and is related to the slope of firm $i$'s reaction function. Namely, $\lambda_i \equiv R_i/(1-R_i)$, where $R_i \in (0,1)$ denotes the slope of firm $i$'s reaction function (in absolute terms). Similarly, $\delta_i$ measures the sensitivity of firm $i$'s equilibrium output response to changes in the checkoff rate.

The change in total output following an arbitrarily small change in the level of advertising sums equation (5) across firms, which gives

$$dQ = \left(\frac{\delta}{(1+\lambda)}\right) d\tau \tag{6}$$

where $\lambda = \sum_i \lambda_i$ and $\delta = \sum_i \delta_i$. Noting that $\lambda_i > 0$ for all $i$ under our assumptions, $\lambda > 0$, and it follows that a marginal increase in the checkoff rate increases the market output level only if $\delta > 0$, where the sign of $\delta_i$ is given by equation (4). The intuition is that the demand facing producers net of the checkoff fee is unaltered by the program when a marginal increase in the checkoff rate of $d\tau$ units leads to a parallel shift in market demand of $p_\tau(Q,\tau)d\tau = d\tau$ units since the unit checkoff fee is entirely passed through to consumers. For a change in the checkoff rate that satisfies $d\tau = p_\tau(Q,\tau)d\tau$, generic advertising that leads to a clockwise rotation of demand, $p_{Q\tau}(Q,\tau)d\tau < 0$, results in a decrease in the equilibrium output level, whereas generic advertising that induces a counterclockwise rotation of demand, $p_{Q\tau}(Q,\tau)d\tau > 0$, results in an increase in the equilibrium output level in the industry.

## 3.2 Industry Optimal Advertising

The objective of the marketing board is to maximize industry profits through the selection of a unit checkoff fee. Given the equilibrium output level in equation (1), the optimal checkoff rate solves

$$Max_\tau \Pi(\tau,\tilde{k}) \equiv \sum_i \pi^i(\tau,\tilde{k}) = p(Q(\tau,\tilde{k}),\tau)Q(\tau,\tilde{k}) - \sum_i c^i(q_i(\tau,\tilde{k}),k_i) - \tau Q(\tau,\tilde{k}).$$

The first-order necessary condition is

$$(p + p_Q Q - \tau)(dQ/d\tau) - \sum_i c^i (dq_i/d\tau) + p_\tau Q - Q = 0, \tag{7}$$

where arguments are suppressed for notational convenience. Substituting $dQ/d\tau = \sum_i dq_i/d\tau$ into equation (7), making use of equation (1), and converting the resulting expression into market shares gives

$$p_\tau - 1 + p_Q \left( \frac{dQ}{d\tau} - \sum_i s_i \frac{dq_i}{d\tau} \right) = 0, \tag{8}$$

where $s_i = q_i/Q$ is the market share of firm $i$. Let $\tau^*$ denote the industry optimal advertising level that solves equation (8).

The intuition for equation (8) is straightforward. The first two terms on the left-hand side are the direct effects of a marginal advertising unit on industry profit. A marginal increase in generic advertising of $d\tau$ units has a direct effect on the net price received by producers of $(p_\tau - 1)d\tau$ units. The remaining term in (8), which can be written $p_Q(\sum_i (1 - s_i)\partial q_i/\partial \tau)$, adjusts the advertising level to account for the oligopoly externality in the market, as externalities between members is something the marketing board can resolve.

It is generally the case that industry output decreases on the margin in response to a clockwise rotation of demand, $p_{Q\tau} < 0$, and increases following a counterclockwise rotation, $p_{Q\tau} > 0$. For instance, consider the symmetric outcome under a standard regularity condition on the elasticity of the slope of inverse demand:

$$E = \frac{-Q p_{QQ}(Q, \tau)}{p_Q(Q, \tau)} \leq 1. \tag{9}$$

Condition (9) rules out cases in which an increase in marginal cost raises industry profits and implies that $\psi \equiv c_{qq} - 2p_Q - Q p_{QQ} > 0$ for the representative firm. Making use of this in equation (6) and imposing symmetry, the change in industry output from a change in the checkoff rate is

$$\frac{\partial Q}{\partial \tau} = \frac{n(p_\tau - 1) + Q p_{Q\tau}}{\psi}. \tag{10}$$

Substituting this term into equation (8) and rearranging gives

$$\left(\frac{p_\tau - 1}{p_{Q\tau}}\right)\psi = -\left(\frac{n-1}{n}\right)Qp_Q. \tag{11}$$

Noting that the right-hand side of equation (11) is positive, it follows that $p_\tau - 1 \stackrel{s}{=} p_{Q\tau}$, where "$\stackrel{s}{=}$" denotes "equals in sign". By inspection of equation (10), industry output decreases on the margin in response to $d\tau > 0$ when $p_{Q\tau} < 0$, and increases when $p_{Q\tau} > 0$.

When a marginal unit of generic advertising involves only a level effect on demand, $p_{Q\tau} = 0$, and satisfies $p_\tau d\tau = d\tau$, the increase in advertising leads to no change in the demand conditions facing producers, and hence has no effect on firm or industry profitability on the margin. The marketing board would cease advertising at this point (since $p_{\tau\tau} < 0$). If advertising combines a level effect on market demand with a clockwise rotation, $p_{Q\tau} < 0$, then industry output decreases in equilibrium, widening price-cost margins for firms selling the advertised good and commensurately raising the return to advertising on the margin. Further advertising is optimal, so that $p_\tau - 1 < 0$ at the industry optimum. Conversely, $p_\tau - 1 > 0$ at the industry optimum when generic advertising induces a counterclockwise rotation of demand, $p_{Q\tau} > 0$.

When firms in an industry have different factor endowments, the advertising level that maximizes industry rents also accounts for changes in allocative efficiency. If advertising redistributes industry output towards firms with "small" capital endowments and away from highly-capitalized firms, this raises industry costs by increasing the market shares of less-efficient firms.[12]

## 3.3 Individually Optimal Advertising

The optimal adverting level for firm $i$ solves

$$Max_\tau \pi^i(\tau, \tilde{k}) \equiv p(Q(\tau, \tilde{k}), \tau)q_i(\tau, \tilde{k}) - c^i(q_i(\tau, \tilde{k}), k_i) - \tau q_i(\tau, \tilde{k}),$$

[12]Such would be the case if advertising decreases the dispersion of consumers' valuations and firms with greater levels of capitalization have steeper marginal cost functions (i.e., $c^i_{qq}(., k_i) > c^j_{qq}(., k_j)$ for $k_i > k_j$).

which is characterized by the rate of change:

$$\frac{d\pi_i}{d\tau} = (p - c_q^i - \tau)\frac{dq_i}{d\tau} + q_i P_Q \frac{dQ}{d\tau} + p_\tau q_i - q_i.$$

Substituting terms from equation (1) gives

$$\frac{d\pi_i}{d\tau} = (p_\tau - 1)q_i + q_i P_Q \frac{d(Q - q_i)}{d\tau}. \tag{12}$$

Each term on the right-hand side of equation (12) has a straightforward interpretation. The first term is the direct effect of advertising on the marginal profit of firm $i$. A change in the check-off rate of $d\tau$ units raises revenue by $p_\tau q_i d\tau$ units and cost by $q_i d\tau$ units. The second term is the indirect effect of advertising on the profit of firm $i$. Holding firm $i$'s output constant, the profit of firm $i$ is influenced indirectly by the change in the market price resulting from the change in output of its rivals, $Q - q_i$, in response to an increase in generic advertising.

Inspection of equations (8) and (12) reveals the difference in industry-optimal and privately-optimal advertising levels. The industry-optimal level of advertising rises in the share-weighted sum of individual output changes, whereas the privately-optimal advertising level rises in the firm's own output change. Formally, evaluating terms in equation (12) at $\tau^*$ gives

$$\left.\frac{d\pi_i}{d\tau}\right|_{\tau=\tau^*} = -q_i p_Q \left[ \left.\frac{dq_i}{d\tau}\right|_{\tau=\tau^*} - \sum_i s_i \left( \left.\frac{dq_i}{d\tau}\right|_{\tau=\tau^*} \right) \right]. \tag{13}$$

Notice that the term in the square brackets goes to zero in the symmetric case, $s_i = 1/n$. That is, all firms desire the industry optimal advertising level in the symmetric case. When the factor endowments of firms differ, rents are redistributed in the industry between firms according to the difference between the change in "own output" and the share-weighted change in industry output.

By inspection of (13), firm $i$ desires a higher level of advertising than $\tau^*$ only if generic advertising expenditures raise the output level of firm $i$ on the margin by more than the increase in the share-weighted output of his rivals. Highly capitalized firms desire a greater level of advertising relative to firms with smaller capital endowments

when generic advertising raises the output level of each firm, which occurs following a counterclockwise rotation of demand.

# 4 Advertising Outcomes and Firm Scale

In this section we follow Perry and Porter (1985) and Farrell and Shapiro (1990) and consider a specialization of the model with linear demand ($p_{QQ} = 0$) and quadratic costs.[13] Specifically, suppose inverse demand is $p(Q, \tau) = \alpha(\tau) - \beta(\tau)Q$ and variable cost for firm $i$ is given by $c(q_i, k_i) = 0.5q_i^2/k_i$.[14] In this case, $c_q^i = q_i/k_i$ and $c_{qq}^i = k_i^{-1}$, so that highly capitalized firms have flatter marginal cost functions (and hence flatter reaction functions) than firms with smaller capital endowments. Advertising messages that produce level effects on market demand affect $\alpha(\tau)$, whereas rotation effects are captured by $\beta(\tau)$.

First-order condition (1) satisfies $\alpha(\tau) - \beta(\tau)Q - \beta(\tau)q_i - (q_i/k_i) = \tau$. This condition can be written as $q_i(\tau) = \kappa_i(\tau)(p(\tau) - \tau)$, where $\kappa_i(\tau) \equiv k_i(1 + \beta(\tau)k_i)^{-1}$ denotes firm $i$'s "adjusted" capital stock. Notice that each firm's output level is proportional to its adjusted capital stock and that changes in the slope of inverse demand alter the adjusted capital stock of each firm. Letting $\kappa(\tau) = \sum_i \kappa_i(\tau)$ denote the aggregate adjusted capital stock, the equilibrium output levels are given by $q_i^*(\tau) = \frac{(\alpha(\tau)-\tau)\kappa_i(\tau)}{1+\beta(\tau)\kappa(\tau)}$, for $i = 1, \ldots n$, and $Q^*(\tau) = \frac{(\alpha(\tau)-\tau)\kappa(\tau)}{1+\beta(\tau)\kappa(\tau)}$.

Notice that the market share of each firm is given by its share of the industry adjusted capital stock, $s_i^* \equiv q_i^*/Q^* = \kappa_i(\tau)/\kappa(\tau)$; hence, advertising influences market share only through changes in the slope of market demand since such changes alter the adjusted capital stocks of individual firms. Differentiating these expressions, individual and aggregate outputs adjust in response to a change in the checkoff fee

[13] Qualitatively similar conclusions emerge in a model with general demand conditions and linear costs.

[14] This cost function, which is homogeneous of degree one, is the dual to a Cobb-Douglas production function with $q = \sqrt{LK}$

according to

$$\frac{dq_i^*(\tau)}{d\tau} = \left(\frac{\kappa_i(\tau)}{1+\beta(\tau)\kappa(\tau)}\right)\left[\alpha'(\tau)-\beta'(\tau)Q^*(\tau)-1\right], \quad (14)$$

$$\frac{dQ^*(\tau)}{d\tau} = \left(\frac{\kappa(\tau)}{1+\beta(\tau)\kappa(\tau)}\right)\left[\alpha'(\tau)-\beta'(\tau)Q^*(\tau)-1\right]. \quad (15)$$

Because the market share of each firm is determined by its share of the industry adjusted capital stock, a change in the level of advertising induces a proportional output adjustment for each firm. Individual output levels rise for all firms in response to a marginal increase in the checkoff rate if $\beta'(\tau)Q^* < \alpha'(\tau) - 1$, and otherwise fall.

The industry optimal solution is characterized by substituting (14) and (15) into (7) and making the substitution $\kappa_i = s_i\kappa$, which yields

$$\frac{(\alpha'(\tau)-\beta'(\tau)Q(\tau)-1)\kappa(\tau)(1-H(\tau))}{1+\beta(\tau)\kappa(\tau)} = \alpha'(\tau)-1,$$

where $H(\tau) = \sum_i (s_i(\tau))^2$ is the Herfindahl index of industry concentration. Rearranging this equation, the industry optimal level of advertising solves

$$\beta(\tau)\kappa(\tau)Q(\tau)\beta'(\tau)(1-H(\tau)) = (1-\alpha'(\tau))(1+\beta(\tau)\kappa(\tau)H(\tau)).$$

This equation implicitly defines $\tau^*$. Notice in the case where generic advertising results in a parallel shift in demand ($\beta'(\tau) = 0$) that the industry optimum involves purchasing advertising messages until the outward shift in demand from the last unit of advertising equates with the level of the per unit check-off fee ($\alpha'(\tau) = 1$).

Under circumstances in which generic advertising leads to a clockwise rotation of demand, $\beta'(\tau) > 0$, the market power of firms in the industry rises, increasing the rents to advertising. Accordingly, advertising shifts market demand on the margin by less than the unit check off rate, $\alpha'(\tau) < 1$. Advertising reduces aggregate output in this case and serves to increase the price cost margins of firms. Conversely, when advertising leads to a counterclockwise rotation of demand, $\beta'(\tau) < 0$, price-cost margins fall on the margin in response to advertising, reducing advertising rents. In this case, advertising shifts market demand on the margin by more than the unit check off rate, $\alpha'(\tau) > 1$.

To assess the advertising preferences of individual firms, substitute (14) and (15) into equation (13) and make the substitution $\kappa_i = s_i\kappa$ to get

$$\left.\frac{d\pi_i}{d\tau}\right|_{\tau=\tau^*} = q_i\beta(\tau)(s_i - H)\frac{dQ^*}{d\tau}.$$

Firm $i$ desires the socially optimal advertising level only when one of two conditions is met: $(i)$ firm $i$ has market share given by $s_i = H$, or $(ii)$ advertising produces a parallel shift in demand on the margin (recall that $dQ/d\tau = 0$ at $\tau^*$ only in the case of a parallel shift). If advertising leads to a clockwise rotation of demand, $\beta'(\tau) > 0$, then $dQ/d\tau < 0$ at $\tau^*$, and "small" firms (i.e., those with market shares that satisfy $s_i < H$) prefer a greater level of advertising than the industry optimal level, whereas, if advertising induces a counterclockwise rotation of demand, $\beta'(\tau) < 0$, then $dQ/d\tau > 0$ at $\tau^*$, and "large" firms (those with market shares that satisfy $s_i > H$) prefer a greater level of advertising than the industry optimal level.

When firms differ in capital endowments, increases in market output are generally distributed according to market share. Highly capitalized firms, which have higher price-cost margins in equilibrium than less capitalized firms, consequently earn a disproportionate share of industry rents from policies that lead to an expansion of industry output. For this reason, advertising messages that result in counterclockwise rotations of demand favor low-cost firms since this increases the price elasticity of demand at the equilibrium point.

# 5 Empirical model and discussion

We draw on data from a survey conducted for the U.S. Department of Agriculture by the Gallup Organization on the attitudes of beef producers towards the Beef Checkoff Program (USDA 2006). These data represent the most comprehensive information available on producer attitudes towards generic advertising and include categorical variables on the size of producers.[15]

[15]The sample was stratified by state and firm size and produced 8004 collected surveys. This sample is representative of a population believed to be around 1 million producers (USDA, 2006).

Our model predicts that small (large) producers receive a disproportionately large share of advertising rents when advertising increases (decreases) the dispersion of consumers' valuations in the beef market. This observation allows us to make inferences on the effect of advertising on market performance by examining the revealed preferences of producers of different sizes for a policy that seeks to expand the checkoff-funded generic advertising program.

The USDA-Gallop survey elicits responses for three questions on producer preferences for the generic advertising. Two questions ask producers to reveal their "blanket-level" support for the Beef Checkoff Program. These questions categorize responses regarding producers' overall level of approval for the program (on a range between "strongly disapprove" to "strongly approve"), and record whether producers would vote to continue the program in a referendum. The response pattern to these questions appeared similar. For example, 77 percent of the sample either "strongly approved" or "approved" the actions of the Checkoff Board, and 79 percent stated that they would be either very likely or somewhat likely to vote to continue the existing Beef Checkoff Program.

The third question is central to our study and asks respondents whether they would prefer to decrease (=1), maintain (=2) or increase (=3) the existing \$1 per head checkoff fee. This question is central to our study since the responses reveal individual preferences for changes in advertising levels on the margin. Only 6.3 percent of respondents preferred a larger checkoff fee to support greater levels of generic advertising.

Table 1 describes the demographic variables in the data. The calculated means are from the 5077 surveys in which definitive responses were provided to all relevant questions.[16] Categorical variables are recorded for age, gender, primary operation type, and secondary operation activities. Additionally, seven size categories are provided, ranging from 1-19 head of cattle in the smallest size category to over 1,000 head in the largest size category. The USDA (2006) provides a thorough descriptive

[16] Surveys with responses of "don't know" or "refused to answer" were dropped from the analysis.

assessment of the survey.

We derive preliminary results from a probit model using size categories to predict preferences for expanding generic advertising levels in the Beef Checkoff Program. We drop the largest size category (SZ7) from the regression and estimate the probability of favoring program expansion for each of the remaining size categories.

Table 2 presents the results of the probit model. Notice that producers in the four smallest categories (SZ1-SZ4) are each statistically less likely to support an increase in checkoff-funded advertising relative to the largest producers, while producers in the three largest categories (SZ5 SZ6 and SZ7) are not statistically different. These preliminary results suggest a positive correlation exists between firm size and the propensity to favor larger levels of generic advertising.

Given the considerable heterogeneity among survey respondents (both observed and unobserved), the relationship between firm size and the propensity to favor greater advertising levels is confounded by a number of econometric issues. To account for heterogeneous factors among producers and the potential correlation between unobserved factors that jointly explain program support and preferences for expanded advertising levels, we estimate a bivariate ordered probit model with the full set of explanatory variables listed in Table 1.

The unobserved propensities of respondents to approve the generic advertising program and favor program expansion are represented by latent constructs $y^*_{j1}$ and $y^*_{j2}$, respectively, which take the form:

$$y^*_{i,1} = \beta_1'\mathbf{x}_{i,1} + \varepsilon_{i,1}, \quad y_{i,1} = j \quad \text{if } \mu_{j-1,1} < y^*_{i,1} < \mu_{j,1}, \tag{16}$$

$$y^*_{i,2} = \beta_2'\mathbf{x}_{i,2} + \varepsilon_{i,2}, \quad y_{i,2} = k \quad \text{if } \mu_{k-1,2} < y^*_{i,2} < \mu_{k,2}, \tag{17}$$

where $\beta_1$ and $\beta_2$ are the coefficient vectors, $\mathbf{x}_{i,1}$ and $\mathbf{x}_{i,2}$ are the exogenous regressors, $\varepsilon_{i,1} \sim N[0,1]$ and $\varepsilon_{i,2} \sim N[0,1]$ are the errors terms, which are assumed to be distributed bivariate standard normal with correlation parameter $\rho$. The $\mu$'s are cutoff values that frame the observed ordered responses. The explanatory variable of interest is the size of grower $i$'s operation, which we measure as the median number of cattle sold in each size category. The remaining variables in $\mathbf{x}_{i,1}$ and $\mathbf{x}_{i,2}$ are

producer-specific attributes that may influence preferences for the generic advertising program.

We refer to equation (16) as the "approval" model and to equation (17) as the "WTP" model. Our primary interest is whether producer size explains the probability that a producer is willing to pay a higher checkoff fee to finance greater advertising levels, after controlling for observed and unobserved factors that explain individual preferences for the program.

We estimate the model using full-information maximum likelihood, which results in consistent estimates for all parameters. We conduct three pretests to evaluate potential parameter fragility and model misspecification. First, we replace the "approval" model with a model that uses voting preferences as the dependent variables in equation (16). Second, we estimate a model that replaces the categorical variable on firm size with the SZ1-SZ6 dummy variables used in our preliminary analysis. Third, we censor the sample to remove 545 out of 5077 respondents who admitted to not being informed on the activities of the Beef Checkoff Program. Our results in each case are robust.

Table 3 presents our estimates of model coefficients with robust standard errors. A chi-square test of the model relative to a null model with all parameters restricted to zero rejects the null ($\chi^2 = 94.58$). A chi-squared test of the correlation coefficient $\rho$, which represents a specification test of the bivariate ordered probit structure, rejects the hypothesis of no cross equation correlation of the errors.

With the exception of the binary variable for dairy operations in the approval model, operation type is not a significant predictor of approval or WTP for the program. However, individual F-tests of the hypotheses that the operation type binary variables are jointly equal to zero are statistically significant in both equations (approval: $\chi^2 = 68.56$; WTP: $\chi^2 = 12.25$).

Relative to the oldest producers (65+), the youngest producers in the sample are more supportive of the checkoff program and are also significantly more likely to support an increase in checkoff-funded advertising levels. This finding suggests a

potential investment component for generic advertising in raising consumer demand for beef in the long run.

The binary terms reflecting secondary operations are insignificant in the approval model, as is the F-test of their joint significance (approval: $\chi^2 = 1.56$). In the WTP model, growers without a secondary operation are less likely to support expansion of the checkoff program and the joint F-test for both binary terms is marginally significant (approval: $\chi^2 = 5.36$)

Notably, after controlling for age, gender, and operational differences among producers, we find that larger operators are significantly more likely to support greater levels of generic advertising. In the WTP model, producers stated their preference for one of three categorical choices over the extent of the generic advertising program: to reduce the $1 per head checkoff fee, to maintain the fee at the existing level, or to increase the checkoff fee. Our results indicate that an increase in operation size results in a rightward shift in the probability density over the choice regions. The bottom rows of Table 3 present the results of a 10% increase in firm size are on the probability distribution. The location of the cut points (cut21=-1.041 and cut22=1.633) in the error structure of the WTP equation define the boundaries from which we measure changes in probabilities in response to the adjustment in firm size (see Greene and Hensher, 2008; Sajaia, 2008). The large cut22 value is representative of the low probability density associated with a preference for program expansion, as only 6.3 percent of respondents supported an increase in checkoff fees above the current level. Overall, a 10 percent increase in firm size of a typical producer results in a 0.58 percent increase in the probability of supporting an expansion of the Beef Checkoff Program and a 0.41 percent decrease in the probability of supporting a contraction. The positive relationship between producer size and the preference for expanding the generic advertising program suggests that advertising has reduced the dispersion of consumers' valuations in the beef market, resulting in a counterclockwise rotation of demand.

Our findings suggest that generic advertising by the Beef Board has improved

market performance. This finding is consistent with the observation of Becker and Murphy (1993, p. 955) that firms may "try to tailor their advertising to bring up the demands of marginal consumers since these drag down the equilibrium price paid by inframarginal consumers." In the case of generic beef advertising, our results are in accord with the views of Ozga (1960), Stigler (1961), Telser (1964) and Nelson (1970, 1974) that advertising enhances performance in markets for advertised goods.

# 6 Conclusions

In this paper we have examined the stated preferences of individual market participants in response to generic advertising programs in the Beef Checkoff Program. We show that small firms benefit disproportionately from generic advertising programs when advertising results in a clockwise rotation of demand, whereas large firms benefit disproportionately from generic advertising programs when advertising leads to a clockwise rotation of demand. This observation provides a simple identification strategy for measuring advertising-induced changes in the market power of advertising firms by examining differences in the preferences of large and small operators for expanding existing generic advertising campaigns.

Our empirical goal is fundamentally descriptive in the sense that we do not propose a "test" for a particular theory of the mechanism through which advertising alters consumers' valuations for advertised goods. Instead, our approach relies on the revealed preferences of individual producers in a collective advertising program to inform on rotation effects in market demand.

We considered the preferences of beef producers towards expanding the generic advertising program as revealed in recent USDA-Gallup data from the U.S. Beef Checkoff Program. We find that the probability that a producer favors expanding the generic advertising program is higher for large producers than for smaller producers, an outcome consistent with an advertising-induced counterclockwise rotation of market demand and a commensurate increase in market performance. This finding is echoed in the recent actions by producers in a number of commodity marketing orders

who have legally challenged mandatory participation in generic advertising programs on the grounds that generic messages are inconsistent with adopting niche market positions. Niche market producers rely on advertising messages to raise the valuations of consumers on the "high WTP" segment of market demand and would benefit accordingly from advertising messages that increase the dispersion of consumers' valuations. Our findings are consistent with this anecdotal evidence and in accord with the views of Becker and Murphy (1993) that the primary role of advertising is to raise the valuation of marginal consumers.

The methodology outlined here for identifying demand rotation effects based on producer preferences for the generic advertising campaigns can be extended to numerous other market. Our approach has direct bearing for the existing Federal marketing orders for beef, cotton, dairy products, potatoes, watermelons, popcorn, peanuts, blueberries, Hass avocados, soybeans, sorghum, pork, honey, fluid milk, eggs, mangoes, mushrooms and lamb, as well as the numerous State marketing orders that rely on generic advertising under the government speech doctrine outlined by the Supreme Court decision in *Johanns et al. v. LMA*. The deeper implications of the *Johanns* decision for government accountability in speech encompass many nonagricultural goods that rely on generic advertising programs for promotion, such as the tourism and propane industries, and have ramifications for cigarette companies compelled to pay for advertising messages that clearly work against their interest. The interpretation of generic advertising programs as a form of government speech suggests a need for future research that examines the effect of generic advertising campaigns on market performance in markets for advertised goods.

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**Table 1. Description of the data**

| | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|
| Expand[a] | 1.9391 | 0.4276 | 1 | 3 |
| Approve[b] | 3.8410 | 1.2360 | 1 | 5 |
| Gen1(Male = 1) | 0.9293 | 0.2563 | 0 | 1 |
| Age1(< 40 yrs.) | 0.0473 | 0.2123 | 0 | 1 |
| Age2(40- 55 yrs.) | 0.2919 | 0.4547 | 0 | 1 |
| Age3 (55-65 yrs.) | 0.2824 | 0.4501 | 0 | 1 |
| Age4 (> 65 yrs.) | 0.3785 | 0.4851 | 0 | 1 |
| Op1 (cow/calf) | 0.7094 | 0.4540 | 0 | 1 |
| Op2 (dairy) | 0.0912 | 0.2879 | 0 | 1 |
| Op3 (farmer/feedlot) | 0.0734 | 0.2611 | 0 | 1 |
| Op4 (feedlot) | 0.0234 | 0.1513 | 0 | 1 |
| Op5 (livestock marketing) | 0.0083 | 0.0905 | 0 | 1 |
| Op6 (seedstock/purebread) | 0.0399 | 0.1959 | 0 | 1 |
| Op7 (stocker) | 0.0433 | 0.2036 | 0 | 1 |
| Op8 (all other) | 0.0108 | 0.1035 | 0 | 1 |
| Nso (no secondary op.=1) | 0.6183 | 0.4859 | 0 | 1 |
| Noco (secondary op. not cattle=1) | 0.1564 | 0.3633 | 0 | 1 |
| Size (category means)[c] | 0.1511 | 0.2377 | 0.01 | 1.5 |

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Notes:
[a]Expand: "In your opinion, should the $1-per-head Beef Checkoff amount increase, decrease or stay the same?"
[b]Approve: "Overall, do you approve or disapprove of the Beef Checkoff program?"
[c]The mean of each size category $SZ_i$ was scaled by a factor of 1000 according the following schedule:
Size=.010: SZ1=1-19
Size=.035: SZ2=20-49
Size=.075: SZ3=50-99
Size=.175: SZ4=100-250
Size=.375: SZ5=250-500
Size=.750: SZ6=500-999
Size=1.50: SZ7=>1000

**Table 2. Probit Analysis of Firm Size**

| Size Category | coefficient | t-statistic |
|---|---|---|
| SZ1 | -.4206** | (-2.39) |
| SZ2 | -.7123*** | (-4.31) |
| SZ3 | -.5050*** | (-3.10) |
| SZ4 | -.6031*** | (-3.62) |
| SZ5 | -.2648 | (-1.51) |
| SZ6 | -.1420 | (-0.69) |
| Constant | -1.0176*** | (-6.58) |

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

**Table 3. Bivariate Ordered Probit Results**

| Approval | coefficient | t-statistic |
|---|---|---|
| op1 | 0.00173 | (0.01) |
| op2 | -0.376*** | (-2.77) |
| op3 | -0.196 | (-1.44) |
| op4 | -0.157 | (-0.97) |
| op5 | -0.0890 | (-0.41) |
| op6 | 0.250 | (1.63) |
| op7 | -0.0957 | (-0.64) |
| gender | 0.175*** | (3.12) |
| age1 | 0.185*** | (2.61) |
| age2 | 0.0556 | (1.46) |
| age3 | 0.0780** | (2.02) |
| nso | 0.0103 | (0.27) |
| noco | 0.0593 | (1.16) |
| firm size | 0.224*** | (2.92) |
| Willingness to Pay | coefficient | t-statistic |
| op1 | 0.0511 | (0.28) |
| op2 | -0.141 | (-0.73) |
| op3 | 0.0519 | (0.27) |
| op4 | -0.128 | (-0.57) |
| op5 | 0.0252 | (0.09) |
| op6 | 0.161 | (0.81) |
| op7 | -0.0594 | (-0.29) |
| gender | 0.0747 | (1.00) |
| age1 | 0.306*** | (3.48) |
| age2 | 0.0685 | (1.50) |
| age3 | 0.0812* | (1.75) |
| noso | -0.0787* | (-1.65) |
| noco | 0.0215 | (0.34) |
| firm size | 0.179** | (1.97) |
| cut21 | -1.041*** | (-5.24) |
| cut22 | 1.633*** | (8.15) |
| $\rho$ | 0.6703 | |
| Ho: $\rho = 0$ | $\chi^2_{(1)} = 1365$ | p-value=0.00001 |
| $N$ | 5077 | |
| Marginal effect of 10% increase in firm size on willingness to pay | | |
| contract checkoff program | | -0.41% |
| no change in checkoff program size | | 0.013% |
| expand checkoff program | | 0.58% |

$t$ statistics in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$