THE ECONOMICS OF INFORMATION WITH APPLICATIONS IN ADVERTISING AND PHILANTHROPIC ORGANIZATIONS

by

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THE ECONOMICS OF INFORMATION WITH APPLICATIONS IN ADVERTISING AND PHILANTHROPIC ORGANIZATIONS

Abstract

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Information is a valuable commodity in the market place. Consumers gather information for products, producers supply information about product prices, quality, characteristics, etc., investors collect information on firms, economic indicators, and trades of others in an effort to increase investment returns, and so on. This quest for information can be broken down to a simple objective: economic agents seek information in order to optimize their well being. Thus, the availability of information can impact behavior.

In this dissertation, I study two distinct ways in which information affects the behavior of economic agents. In the first two chapters, I study why producers have an incentive for supplying advertising content that is generally dismissed in standard economic models of advertising. I find that consumer preferences lead to profit motives for firms to invest in this type of advertising content. A content analysis of television advertisements lends support to my models by revealing the frequencies of various types of advertising content.

In the third chapter, I demonstrate how information about changes in tax structures affect the behavior of philanthropic organizations. Specifically, the tax rate cuts associated with the Jobs Growth and Tax Relief Reconciliation Act of 2003 resulted in an adjustment in the behavior of nonprofit organizations. In my empirical analysis, I find that the passage
of the tax law resulted in a decrease in the effectiveness of non-employee related fundraising expenses, but an increase in the effectiveness of employee related fundraising expenses. These changes are associated with a decrease in average non-employee related fundraising expenses and an increase in employee related fundraising expenses. These findings are important for philanthropic organizations so they can understand how to respond to such policies and maintain desired levels of services.
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Dedication

This dissertation is dedicated to my wife and daughters who have always believed in me.
CHAPTER 1. OPPORTUNITY KNOCKS: AN ECONOMIC ANALYSIS OF TELEVISION ADVERTISING

Abstract

Certain aspects of advertising—especially on television—are not easily explained with conventional economic models. In particular, much of the imagery and repetitive thematic content seen in advertisements seem “psychological” in nature, as opposed to “informative.” To understand the economic rationale for this phenomenon, I develop a theory of endogenous preferences in which information about threshold payoffs (which I interpret as being present over the course of human evolutionary history) induces sudden shifts in demand. I show that the resulting demand functions give firms incentive to provide threshold-related information.

To examine the use of threshold-related content in practice, I study a sample of 370 television advertisements. I find occurrences of threshold-related content in 83% of food and beverage advertisements for children and in 71% of advertisements for general audiences. Furthermore, the threshold-related content in children’s food and beverage advertisements occurred with statistically greater frequency than factual content, which was not true for food and beverage advertisements aimed at general audiences.
1.1 Introduction

Advertising plays a critical role in a market economy. By conveying information about price, quality, and the existence of new products, advertisements facilitate exchange, expand sales, and enhance competition. A rich theoretical literature has developed in economics that sheds light on the conditions under which firms will advertise, the types of products they advertise, the types of information advertisements convey, and the means through which advertisements reach consumers.

Many advertisements, especially those on television, contain images and thematic content that is generally understood as uninformative in conventional economic models. Social psychologists and marketing professionals, however, have devoted a great deal of energy (and considerable sums of money) to the task of understanding the hidden motives of the consumer, and the subtle—and evidently information-free—ways in which advertisements can influence consumer behavior.

Our objective is to propose an economic rationale for the use of advertising content that is more “psychological” in nature. I am especially interested in the way in which such content can lead to shifts in product demand, as well as the payoff structure available to producers. I draw upon the theory proposed in Smith and Tasnádi (2007, 2009) and develop a model in which seemingly psychological aspects of television advertisements can be viewed as informative signals about potential opportunities that are designed to induce non-convexities in consumer preferences. These non-convexities in preferences correspond to shifts in demand. Producers respond to this behavior by sending messages, in the form of advertisements, in an attempt to capture as much of the market as possible. The theory also generates *ex ante*
predictions about ad content that I use to interpret the content I observe in a sample of television advertisements.

1.2 Background

The social function of advertising is undoubtedly the provision of information concerning the prices and qualities of goods and services available in the markets (Kaldor, 1950).

Economic theories of advertising have for the most part aligned with Kaldor’s (1950) classic summary. Profit maximizing firms, however, are not concerned about how product information enhances social welfare. Their end goal is to increase profits, and advertising can act as a means to generate potential transactions. Therefore, from a producer’s perspective, information provision in advertisements is a means to an end, the end being increased demand for the product.

Though much of the economic analysis of advertising has abstracted from questions of information, work by Nelson (1970, 1974), and Milgrom and Roberts (1986), demonstrates the way in which advertisements inform buyers about product characteristics and/or signal product quality. Moreover, Anderson and Renault (2006) demonstrate how a producer can strategically provide information about product characteristics, and/or, price and still affect

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1Stigler and Becker (1977) and Becker and Murphy (1993) suggest that advertisements and the respective product are complements, so increases in the level of advertising can increase demand for the product. Dixit and Norman (1978) also propose a model where advertising shifts demand, though they argue that it is through a change in tastes. This is in contrast to the theory of stable preferences in Stigler and Becker (1977).
consumer demand. In each of these articles, advertisements result in demand shifts as preferences remain unchanged.

In addition to demand shifts, Dorfman and Steiner (1954) suggest that advertisements can also change the shape, or position, of demand. As a very clever extension to Dorfman and Steiner (1954), Johnson and Myatt (2006) demonstrate theoretically that information related to product characteristics, features, and price–hype–all shift market demand, while information about product style and appeal–real information–rotates market demand.\(^2\) These types of rational agent models emphasize that agents respond to advertisements that contain product information directly related to product characteristics, price, and quality, or simply because the advertisement exists (product recognition, repetition). A significant amount of the content in advertisements, especially those on television, however, is more thematic in nature.\(^3\) There are theoretical and empirical motivations for arguing that thematic-type content can also affect demand.

To begin with, Chakraborty and Harbaugh (2010), show how a biased expert can make use of "cheap talk", i.e., unverifiable messages, to influence a decision maker.\(^4\) Furthermore, Mullainathan et al. (2008) model how advertisers use what may be considered uninformative content to create associations that can affect consumer behavior.\(^5\)

\(^2\)Meyerhoefer and Zuvekas (2008) find that direct-to-consumer advertising of pharmaceuticals both shifts and rotates demand.

\(^3\)Although Kaldor (1950) envisioned the function of advertising as providing information in the marketplace, he recognized that in practice, advertisements deviated from this view.

\(^4\)This work is related to the Crawford and Sobel (1982) model of information transmission.

\(^5\)In their model, they assume that certain agents ("coarse thinkers") store information in categories where
In the realm of social psychology and marketing, Heath et al. (2009) report evidence that advertisements with more emotional content had a greater effect on product perception when compared to responses to advertisements with more informational content. There is also evidence that music (Gorn, 1982; Keplaris and Cox, 1989) and environment (Dijksterhuis et al., 2005) influence consumer behavior. Both music and environment send very distinct contextual cues. Recently, Patrick Edson, the MillerCoors VP of marketing and innovation said, “Great organizations get to focus on a real rich area, which is our ability to decipher consumers’ unarticulated needs and unconscious behaviors” (Ad Age, 2009, emphasis added). There is plenty of evidence that social psychologists and marketing experts recognize the efficacy of situational content in advertising.

Exactly how these situational-type messages work is not completely understood, but it is important to note that various studies have provided evidence that content can affect consumers in ways that escape the notice of consumers. For example, Langmaid and Gordon (1988) report that hypnotized subjects were able to recall almost every detail of previously viewed television advertisements. This was in contrast to non-hypnotized subjects who did not recall the advertisements very well at all. Furthermore, Schacter (1996) found that people tend to prefer products in ads they just saw, even when they do not remember having seen the advertisement. Gazzaniga (2000) reports on the results from multiple studies of subjects

---

two items in the same category are linked by some association, or analogy. Advertisers (“persuaders”) can improve the perception of one item in a category by providing positive information about another item in the same category. Alternatively, advertisers can create new analogies the agent had not previously developed.

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6This statement was part of a seminar given at the 2009 Association of National Advertisers Branding Conference. Edson’s statement followed 14 consecutive quarters of sales growth for MillerCoors.
whose left and right brain hemispheres were surgically separated. In one of the studies, for example, subjects were shown pictures while covering the left eye. The subjects then responded to commands as if they had seen the picture, without recalling actually seeing the picture. Thus, there is recurring evidence in the literature that suggests advertising content has the potential to affect consumer behavior in ways unnoticed by the consumer.

In a recent study, economists Bertrand, Karlan, Mullainathan, and Zinman together with psychologist Shafir (Bertrand et al., 2010) report the results of a field study where they varied the creative content of a mail flyer that advertised consumer loans. They report that surprisingly minor changes to the printed mailer had large effects on response rates. Despite this result, they wrote, “I found it difficult to predict ex ante which types and variations of creative content would affect demand. This fits with a central premise of psychology—context matters—and suggests that pinning down the effects that will matter in various market contexts might require systematic field experimentation on a broad scale” (p. 302).

I would add that a more powerful predictive theory is needed to complement this ambitious goal. The objective here is to develop a theory that will represent a step in this direction.

I build on the work of Johnson and Myatt (2006) by classifying what type of content affects demand. I examine, however, the issue of content outside the realm of hype and real information, i.e., content that is thematic in nature. Our approach is to formulate a simple

---

7See Petty, Cacioppo and Schumann (1983) and Heath (2001) for interesting details regarding mental processing of received messages.

8Sutherland (2008) points out that advertising affects behavior in subtle ways, and that the mystical concept of “subliminal” advertising is merely a myth.
problem—achieving a threshold level of some “quality”—that approximates a broad class of adaptive problems faced by the human species over the course of evolutionary history.

Since the effects of uninformative content are more psychological (and, it is becoming increasingly apparent, biological) in nature, it seems natural to consider the evolutionary origins of consumer behavior. In the pre-industrial era, humans necessarily learned to respond to states of nature, e.g., environmental, social, familial, and other cues, to maintain health, survive, and successfully reproduce. Even though situations and responses to situational cues can change over time (see Konner, 2002), the underlying motivations to maintain good health, survive, and reproduce have been an integral part of human evolutionary history.

Consistent with human evolutionary history, the consumer in the model responds to cues about the threshold levels of quality that correspond directly to states of nature. This behavior provides the incentive for advertisers to send signals with the expectation of influencing a consumer’s beliefs about threshold levels. Specifically, I think of the advertiser as sending messages about potential opportunities, that is, achieving a threshold level of quality when success is uncertain. The opportunities to which I refer are transitions from one state of nature to another, i.e., transitioning from a low probability, high threshold state to a state where product consumption is associated with obtaining the threshold. The message about the high threshold state is that favorable outcomes—health, survival, finding a mate—are never certain, so one should “watch out” for the negative effects of not achieving

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9Responses of this nature may seem more instinctive than psychological. The biological mechanisms through which responses to various cues develop, however, are the root of human psychology and not at all separate from it. According to Konner (2002), “The body displays ancient signals and concomitants of emotion; yet these reactions are not the emotion itself and they do not account for the control of fear and flight, which must be sought in the brain.”
the threshold.

I begin with a theoretical context that follows Smith and Tasnádi (2007) where an agent has preferences for product quality and prefers to consume at least $k$ units of that quality. They assume that the amount of quality in the choice of consumption goods is unknown, but the distribution of quality is known and equivalent for the goods. As a result, when the chance of achieving the threshold level of quality is high, consumers will choose a combination of goods, i.e., behave in a risk-averse manner. On the other hand, when the chance of achieving the threshold is low, consumers will specialize in consumption of one of the goods, i.e., behave in a risk-taking manner. This translates into demands which are discontinuous in $k$. I refer to behavior of this sort as situationally dependent; the consumer will change consumption decisions based on the available information about the threshold $k$. I then examine the behavioral implications of this preference structure in a competitive market framework. Under certain conditions, I show that competing duopolists have an incentive to expend resources in an effort to influence the consumer's perception about the threshold $k$ and obtain a greater share of the market. Our theory not only provides an explanation for the repeated use of situational-type content, but it also provides ex ante predictions about the type of content an advertiser would select. A discussion of results from a content analysis of television advertisements follows. Finally, I conclude with suggestions for future research.

1.3 Advertising and Endogenous Preferences

In economic theory, it is standard practice to assume stable preferences over consumption goods. I propose a model where preferences are defined with respect to latent
qualities or outcomes, so that preferences for goods are sensitive to information regarding
the threshold level of quality. Preferences of this nature will allow me to demonstrate how
information about threshold can affect product choice.

1.3.1 Utility in the Presence of a Quality Threshold

The household production model is one useful method for analyzing preferences for
qualities.\(^{10}\) A consumer uses goods purchased in the marketplace, along with time, human
capital, and other training to produce non-market goods, i.e., desired qualities. The produc-
tion function for these home produced goods may exhibit decreasing, constant, or increasing
returns to scale.

In the general case, assume that a consumer has preferences defined over a set of non-
market goods, \(Z_1, ..., Z_n\), which represent qualities the consumer desires to consume, e.g.,
flavor, nutrition, and style. The consumer takes the market prices as given and purchases
market goods, \(x_1, ..., x_m\), and uses these to produce non-market goods via household produc-
tion technologies \(Z_j = h_j(x_1, ..., x_m)\). The household production technolgies may include
human capital, time, and other training. For simplicity, I assume the \(Z_j\)s are linear functions
of the \(x_i\)s, and that human captial, time, and other training are fixed and homogenous across
consumers.

I assume that there are two market goods, \(x\) and \(y\), and one quality, \(Z\). The consumer’s

\(^{10}\)See Lancaster (1966) and Stigler and Becker (1977). The Stigler and Becker (1977) article includes a
section on advertising.
decision problem is to maximize utility subject to his resource constraint and the household production constraint, i.e.,

$$\max U(Z) \quad \text{s.t.} \quad m = p_x x + p_y y, \quad Z = \alpha_x x + \alpha_y y,$$

where $\alpha_x$ and $\alpha_y$ represent the technology used to transform the qualities in $x$ and $y$ to the desired quality $Z$.

One of the assumptions of the household production model is that the quality of the market goods is known. When the consumer produces quality $Z$ with goods $x$ and $y$, the consumer knows exactly the amount of $Z$ he will consume. I relax this assumption and study the situation where quality of the market goods is unknown, but the distribution of quality in each of the goods is known. Both $x$ and $y$ are fixed amounts but I will let $\alpha_x$ and $\alpha_y$ be random variables which characterize the distribution of quality in their respective market goods. Since the level of a particular quality in both goods is unknown, $Z$ is also a random variable. Furthermore, the utility function $U(Z)$ is now itself a random variable, and I assume that $U(Z)$ has the expected utility form so that the expected value of $U(z)$ can be written as

$$\int_0^\infty U(z)f(z)dz,$$

where $z$ is the outcome of $Z$ and $f(z)$ is the probability density function of $Z$.

I impose one final restriction and assume that the combination of $x$ and $y$ must achieve a threshold level $k$ or utility is 0. Specifically, I can think of utility as 0 when the combination of $x$ and $y$ yields a quality level below $k$, and utility equals 1 when the combination of $x$ and
yields a quality level greater than \( k \). As a result, the expected utility form simplifies to

\[
\int_{k}^{\infty} f(z)dz
\]

which characterizes both the expected utility, and probability, of achieving the threshold level \( k \). The decision problem can be restated as the consumer maximizing the probability of achieving a threshold level \( k \). In the context of human evolutionary history, I will refer to the threshold level as good health, survival, and finding a mate.

Tasnádi et al. (2010)\(^{11}\) focus on this simplified version of the household production model and show that if consumers choose goods so as to maximize the probability of achieving some threshold level of quality, new information about the threshold level (provided, perhaps, by an advertisement) can induce non-convex preferences over goods and sudden shifts in demand. In what follows, I briefly discuss a modified version of their consumer decision problem. Then, I apply the consumer’s decision problem to a duopoly game in which firms compete by choosing price and advertising levels.

As mentioned previously, a consumer is faced with a menu of two goods, \( x \) and \( y \), and must choose how much of each to consume, given income \( m \) and prices \( p_x \) and \( p_y \), respectively. There is a single unobservable characteristic (“quality”) for which there is a critical threshold: the consumer seeks only to maximize the probability that he consumes \( k \) units of this quality. The amounts of the unobservable quality per unit of \( x \) and \( y \) are independent random variables, denoted \( \alpha_x \) and \( \alpha_y \), with distribution functions \( F \) and \( G \),

\(^{11}\)The model in Tasnádi, Smith and Hanks (2010) is very similar to that in Smith and Tasnádi (2009), and both models are a more specific version of Smith and Tasnádi (2007).
respectively. Formally, the consumer’s utility function is given by

\[ V(x, y) = \int_{k}^{\infty} f(z)dz = P(\alpha_x x + \alpha_y y \geq k), \quad (1.3) \]

and his decision problem can be stated:

\[
\begin{align*}
\max_{x,y} & \quad V(x, y), \\
\text{s.t.} & \quad p_xx + p_yy \leq m, \\
& \quad x, y \geq 0.
\end{align*}
\]

(1.4)

I assume that the random variables \(\alpha_x\) and \(\alpha_y\) are distributed according to the uniform distribution on the interval \([0, 1]\). Then the utility function (1.3) is given by

\[
V(x, y) = \int_{k}^{\infty} \int_{\max\{0, t-y\}}^{\min\{x, t\}} \frac{1}{xy} f\left(\frac{z}{x}\right) g\left(\frac{t-z}{y}\right) dzdt
\]

(1.5)

which requires integration across five distinct regions in commodity space, which I illustrate in Figure 1.0.\footnote{See Smith and Tasnádi (2007) for a complete proof.}

Following Smith and Tasnádi (2007, 2009), I will refer to these regions as follows: the “death zone”

\[ A^0 = \{(x, y) \in \mathbb{R}_+^2 \mid x + y \leq k\} \]

in which the probability of meeting the threshold is zero, the low-probability region

\[ A^{-} = \{(x, y) \in \mathbb{R}_+^2 \mid k < x + y, x \leq k, y \leq k\} \]
in which the probability of meeting the threshold is positive but the consumption levels of both goods are small (i.e., \(x, y \leq k\)), the region
\[
A^{-+} = \{(x, y) \in \mathbb{R}^2_+ \mid x \leq k, k < y\}
\]
in which the consumption level of \(x\) is small, the region
\[
A^{+-} = \{(x, y) \in \mathbb{R}^2_+ \mid k < x, y \leq k\}
\]
in which the consumption level of \(y\) is small, and the region
\[
A^{++} = \{(x, y) \in \mathbb{R}^2_+ \mid k < x, k < y\}
\]
in which the consumption levels of both \(x\) and \(y\) are large relative to the size of the threshold.

Integration of (1.5) yields
\[
U(x, y) = \begin{cases}
0 & \text{if } 0 \leq x + y \leq k, \\
1 - \frac{k}{x} + \frac{y}{2x} + \frac{(k-x)^2}{2xy} & \text{if } x + y > k, x \leq k \text{ and } y \leq k, \\
1 + \frac{y}{2y} - \frac{k}{y} & \text{if } x + y > k, x \leq k \text{ and } y > k, \\
1 + \frac{x}{2x} - \frac{k}{x} & \text{if } x + y > k, x > k \text{ and } y \leq k, \\
1 - \frac{k^2}{2xy} & \text{if } x + y > k, x > k \text{ and } y > k.
\end{cases}
\]

Note that utility is zero in region \(A^0\), strictly convex in region \(A^{-+}\), linear in \(A^{+-}\) and \(A^{++}\), and strictly concave in region \(A^{++}\), as shown in Figure 1.1 (Smith and Tasnádi, 2007, 2009).

Based on the above utility function, I derived the correspondences for \(x\) and \(y\) that
solve the decision problem in equation (1.4). Specifically, $(x^*, y^*) \in$

\[
\begin{align*}
\mathcal{D} := \begin{cases}
\left\{ \left( \frac{m}{2p_x}, \frac{m}{2p_y} \right) \right\} & \text{if } \frac{m}{2p_x} > k \text{ and } p_x \geq p_y; \\
\left\{ \left( 0, \frac{m}{p_y} \right) \right\} & \text{if } \frac{m}{2p_x} < k \text{ and } p_x > p_y; \\
\lambda \left( \frac{m}{2p_x}, \frac{m}{2p_y} \right) + (1 - \lambda) \left( 0, \frac{m}{p_y} \right), \lambda \in [0, 1] & \text{if } \frac{m}{2p_x} = k \text{ and } p_x > p_y; \\
\left\{ \left( \frac{m}{p_x}, 0 \right) \right\} & \text{if } \frac{m}{2p_y} > k \text{ and } p_x < p_y; \\
\lambda \left( \frac{m}{2p_x}, \frac{m}{2p_y} \right) + (1 - \lambda) \left( \frac{m}{p_x}, 0 \right), \lambda \in [0, 1] & \text{if } \frac{m}{2p_y} = k \text{ and } p_x < p_y; \\
\left\{ \left( 0, \frac{m}{p_y} \right), \left( \frac{m}{p_x}, 0 \right) \right\} & \text{if } \frac{m}{2p_x} < k \text{ and } p_x = p_y; \\
\left\{ \left( \frac{m}{p_y} - \lambda, \lambda \right), \lambda \in [0, \frac{m}{p_x}] \right\} & \text{if } \frac{m}{2p_x} = k \text{ and } p_x = p_y.
\end{cases}
\]

if positive utility levels are attainable ($\frac{m}{p_x} > k$ or $\frac{m}{p_y} > k$). These demands are set-valued in four cases. For simplicity, I resolve this indeterminacy by assuming that the consumer spends his money equally between the two products whenever possible. However, this is not possible if $\frac{m}{2p_x} < k$ and $p_x = p_y$. In this case, I assume that the consumer randomizes between the two corner solutions by choosing either with probability $1/2$. A key result from the consumer’s decision problem is that demand is discontinuous in the threshold parameter $k$. In Figure 1.2 we show how the presence of a high threshold leads the consumer to specialize in consumption of one good. This behavior is an attempt to shift as much probability mass as possible to the event of obtaining the favorable outcome.

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13See Smith and Tasnádi (2007, 2009); Tasnádi et al. (2010).

14Resolving indeterminacy in this way guarantees the existence of an equilibrium in pure strategies in Proposition 1. Otherwise, there would exist many $\varepsilon$-equilibria in pure strategies close to the solution given in Proposition 1.
The indifference curves in $x, y$-space demonstrate concave preferences below the threshold and convex preferences above the threshold. Quality of $x$ and $y$ is not observed until they are consumed, thus the consumer must allocate resources in such a way that the probability of achieving the threshold is maximized. When the threshold is high, the consumer will specialize in one good and when the threshold is low, he will consume a combination of the goods, since this will yield a higher probability of achieving the threshold. This behavior can be understood as risk-taking when the threshold is high and risk-averse when the threshold is low. As mentioned above, the risk-taking strategy is optimal when $k$ is high because the consumer wishes to shift as much probability mass as possible to the favorable outcome.

1.3.2 Thresholds

Our theory emphasizes a binary outcome (satisfaction of a threshold) both because it is an analytically tractable assumption, and because it represents a broad class of adaptive problems likely to have been important in human evolutionary history. Most generally, evolutionary biologists typically sort evolutionary forces between those acting via natural selection (e.g., survival), and those acting via sexual selection (e.g., reproduction). Survival (i.e., live or die) and reproduction (i.e., find a mate or don’t; produce an offspring or not) are the starkest of binary outcomes, and they still affect behavior today, in ways big and small. Of course, outcomes are never certain, and perfect information about important life events has

\footnote{In their book \textit{How Humans Evolved}, Boyd and Silk (2009) explain, “...we have focused on reproductive behavior because mating and parenting strongly affect fitness.”}
never been readily available, so the behavioral implications of underlying threshold payoffs will necessarily be dominated by responsiveness to available information.

It is also important to recognize that the preference structure presented above directly relates to situation-dependent utility. In other words, the consumption decision is affected by the current level of $k$. This is similar to the work by Caplin and Leahy (2004) where a “concerned expert” determines whether it is optimal to fully reveal the true state of the world to a recipient whose utility is affected by evolving beliefs about the current state of the world, as well as observed outcomes.\textsuperscript{16} Such models of belief dependent utility provide important insights for understanding why context matters in advertisements. In what follows, I will show how firms make use of the belief dependent utility by providing information about the threshold level of quality.

\textbf{1.3.3 Simple duopoly game}

Here, I develop a model with competing duopolists and show that the presence of the threshold affects pricing and advertising decisions. In the market there are two competing duopolists, firms $x$ and $y$, that set prices $p_x$ and $p_y$, respectively. Moreover, the firms can manipulate the consumer’s threshold level with advertisement levels $\delta_x$ and $\delta_y$, respectively. The firms have linear cost functions with respective positive unit costs $c_x$ and $c_y$. The demand functions $D_x$ and $D_y$ of the two firms are derived from the utility maximization

\textsuperscript{16}Utility of this nature is directly related to utility in psychological games. These games were first studied by Geanakoplos, Pearce and Stacchetti (1989).
problem of the representative consumer described in the previous section. The firms’ profit functions equal

\[ \Pi_i(p_x, p_y, \delta_x, \delta_y) = D_i(p_x, p_y, k + \delta_x + \delta_y)(p_i - c_i) - a\delta_i^2, \]

where \( a \) is a positive parameter for advertisement costs, and \( i = x, y \). In what follows I will assume that \( c_x < c_y \).

The duopolists interact in a three stage game where in the first stage, the low-cost firm chooses its advertising strategy, \( \delta_x \). In the second stage, the high-cost firm reacts by choosing \( \delta_y \), and finally the firms set their prices simultaneously. To simplify the analysis, I assume that firm \( y \) stays out of the market if it cannot make positive profit. This simplification implies a modification of the results from Tasnádi, Smith and Hanks (2010), which determine the Nash equilibrium of the final subgame. Hence, I obtain the following results for the final subgame.

**Proposition 1.** If \( \frac{m}{2c_y} > k \), then there exists a unique Nash equilibrium in which both firms set price \( p^* = \frac{m}{2k} \).

When I enter a different region of the commodity space, the pricing decision for the firms changes. Proposition 2 demonstrates this change.

**Proposition 2.** If \( \frac{m}{c_x} \geq k \geq \frac{m}{2c_y} \), then firm \( x \) will drive firm \( y \) out of the market by setting price \( c_y \).

Finally, I mention the case in which firms \( x \) and \( y \) can just sell their products by taking a loss. In this case the firms can stay out of the market by setting sufficiently high prices.
Proposition 3. If \( k > \frac{m}{c_x} \), then firms \( x \) and \( y \) stay out of the market by setting prices above their respective unit costs.

I will now introduce the situation where the duopolists can advertise. Consider Propositions 1 and 2. It appears that if \( \frac{m}{2c_x} > k \) and \( \frac{m}{2c_y} > k \), then firm \( x \) could benefit from increasing the threshold level to move the consumer into region \( \frac{m}{2c_x} > k + \delta > \frac{m}{2c_y} \). Clearly, firm \( y \) has opposite incentives. Recall that demands are discontinuous functions of the threshold, so the relative magnitude of \( k \) will affect firm behavior.\(^{17}\)

I solve the advertising and pricing game by backwards induction. If the firms set \( \delta_x \) and \( \delta_y \) in the first two stages, then these decisions are sunk costs in the final stage. Thus, the final subgame reduces to the game covered by Propositions 1, 2 and 3, where \( k \) has to be replaced with \( \tilde{k} = k + \delta_x + \delta_y \). The selected values for \( \delta_x \) and \( \delta_y \) determine, which proposition of Propositions 1, 2 and 3 must be applied for the final price-setting stage. For instance, by Proposition 1, the firms set prices \( p = p_x = p_y = \frac{m}{2k} \) if \( \frac{m}{2c_y} > \tilde{k} \).

Now I turn to stage 2 in which \( \delta_x \) is given. The profit function of firm \( y \) equals\(^ {18}\)

\[
\Pi_y(\delta_y) = \begin{cases} 
\frac{m}{2} - (k + \delta_x + \delta_y)c_y - a\delta_y^2 & \text{if } \frac{m}{2c_y} > k + \delta_x + \delta_y > 0, \\
-a\delta_y^2 & \text{if } \frac{m}{2c_y} \leq k + \delta_x + \delta_y \text{ or } k + \delta_x + \delta_y \leq 0.
\end{cases}
\]

By taking the first-order condition of the first case, I obtain that \( \delta_y^* = -\frac{m}{2a} \) solves the profit maximization problem of firm \( y \) if \( \frac{m}{2c_y} > k + \delta_x + \delta_y^* > 0 \) and \( \Pi_y(\delta^*) > 0 \). Since the latter

\(^{17}\)I focus on the case when \( k \) is sufficiently high to allow use of standard optimization techniques. When \( k \) is relatively low, I rely on suprema instead of maxima to study equilibrium conditions.

\(^{18}\)Based on the two sentences following equation (1.6) it can be verified that \( \Pi_y \) is nonnegative.
inequality is equivalent to $\frac{m}{2c_y} > k + \delta_x - \frac{c_y}{4a}$ condition $\frac{m}{2c_y} > k + \delta_x + \delta_y^*$ is less restrictive than $\Pi_y(\delta^*) > 0$, and thus, I obtain the following 'best response function':

$$\delta_y^*(\delta_x) = \begin{cases} 
-\frac{c_y}{2a} & \text{if } \frac{m}{2c_y} > k + \delta_x - \frac{c_y}{4a} \text{ and } k + \delta_x - \frac{c_y}{2a} > 0, \\
0 & \text{if } \left( \frac{m}{2c_y} \leq k + \delta_x - \frac{c_y}{4a} \text{ and } k + \delta_x - \frac{c_y}{2a} > 0 \right) \text{ or } \\
(k + \delta_x - \frac{c_y}{2a} \leq 0 \text{ and } \frac{m}{2} - a(k + \delta_x)^2 \leq 0), \\
-k - \delta_x & \text{if } k + \delta_x - \frac{c_y}{2a} \leq 0, \text{ and } \frac{m}{2} - a(k + \delta_x)^2 > 0.
\end{cases}$$

I have an interior solution in the first case, while for the second case Propositions 2 and 3 apply for the terminal subgame; in particular, firm $y$ stays out of the market. In the third case, the best reply function for firm $y$ demonstrates that as the threshold decreases in magnitude, interior solutions no longer obtain and I must rely on suprema instead of maxima concerning the profits of firm $y$. The definition of the best reply by

$$\delta_y^{\text{sup}} = -k - \delta_x,$$

(1.7)

is motivated by the fact that

$$\sup \left\{ \Pi_y(\delta_y) \mid \frac{m}{2c_y} > k + \delta_x + \delta_y > 0 \right\} = \lim_{\delta_y \to (-k-\delta_x)^+} \Pi_y(\delta_y)$$

if $k + \delta_x - \frac{c_y}{2a} \leq 0$.20

Finally, I determine the first-stage action of firm $x$. Taking the reaction of firm $y$ into account and assuming that firm $x$ has to enter the market even if it makes losses, firm $x$’s

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19 In some cases a best response does not exist. In these cases, I have considered the appropriate sup value of the profit function.

20 This is equivalent to changing the demand and profit functions at threshold level 0 in order to simplify the analysis. If under this modified specification an equilibrium with $k + \delta_x + \delta_y = 0$ arises, the original game has many $\varepsilon$-Nash equilibria close to the determined solution of the modified game.
profit function is given by

$$\Pi_x(\delta_x) = \begin{cases} 
\frac{m}{2} - (k + \delta_x - \frac{c_y}{2a})c_x - a\delta_x^2 & \text{if } \frac{c_y}{2a} - k < \delta_x < \frac{m}{2c_y} - k + \frac{c_y}{4a}, \\
m - \frac{m}{c_y}c_x - a\delta_x^2 & \text{if } \frac{m}{2c_y} - k + \frac{c_y}{4a} \leq \delta_x \leq \frac{c_y}{2a} - k, \\
m - \frac{m}{c_y}c_x - a\delta_x^2 & \text{if } \sqrt{\frac{m}{2a}} - k \leq \delta_x \leq \frac{c_y}{2a} - k, \\
\frac{m}{2} - a\delta_x^2 & \text{if } -k \leq \delta_x < \sqrt{\frac{m}{2a}} - k \text{ and } \delta_x \leq \frac{c_y}{2a} - k, \\
-a\delta_x^2 & \text{if } \delta_x < -k.
\end{cases}$$

In order to simplify the presentation of the results and to decrease the number of possible scenarios, I assume that firm \( x \) enters the market. I will refer to the regions corresponding to the above five regions by (i)-(v), respectively. One can check that \( \Pi_x \) is piecewise continuous and differentiable, where the appropriate intervals can be obtained by looking at the boundaries of the five regions. Observe that region (iii) is empty if \( 2ma > c_y^2 \), while region (i) is empty if \( 2ma < c_y^2 \). Hence, I have to check \( \Pi_x \) either on the intervals \((-\infty, -k), (-k, \frac{c_y}{2a} - k), \left(\frac{c_y}{2a} - k, \frac{m}{2c_y} - k + \frac{c_y}{4a}\right), \left(\frac{m}{2c_y} - k + \frac{c_y}{4a}, \infty\right) \) or \((-\infty, -k), (-k, \sqrt{\frac{m}{2a}} - k), \left(\sqrt{\frac{m}{2a}} - k, \frac{m}{2c_y} - k + \frac{c_y}{4a}\right), \left(\frac{m}{2c_y} - k + \frac{c_y}{4a}, \infty\right) \).

Let \( \Pi_x^i(\delta_x) = \frac{m}{2} - (k + \delta_x - \frac{c_y}{2a})c_x - a\delta_x^2, \Pi_x^{ii}(\delta_x) = \Pi_x^{ii}(\delta_x) = m - \frac{m}{c_y}c_x - a\delta_x^2, \Pi_x^{iv}(\delta_x) = \frac{m}{2} - a\delta_x^2 \) and \( \Pi_x^v(\delta_x) = -a\delta_x^2 \), where all five functions are assumed to be defined over the entire real line (and not only above the respective intervals one should expect from \( \Pi_x \)). The maximum values for \( \Pi_x^i, \Pi_x^{ii} \) and \( \Pi_x^{iv} \) are achieved at \(-\frac{c_y}{2a}, 0\) and 0, respectively. It can be verified that \( \Pi_x^i\left(\frac{c_y}{2a} - k\right) = \Pi_x^{iv}\left(\frac{c_y}{2a} - k\right) \).
An Interesting Case

In the following proposition, I demonstrate that the low-cost firm will use information about thresholds in advertisements to drive the high-cost firm out of the market.\(^\text{21}\)

**Proposition 4.** If \(\frac{c_y}{2a} - k < -\frac{c_y}{2a} \), \(0 < \frac{m}{2c_y} + \frac{c_y}{4a} - k\) and

\[
\Pi^i_x \left( \frac{m}{2c_y} + \frac{c_y}{4a} - k \right) > \Pi^i_x \left( -\frac{c_y}{2a} \right),
\]

then the low-cost firm drives the high-cost firm out of the market by increasing the consumer’s threshold level via advertisements \((\delta_x = \frac{m}{2c_y} + \frac{c_y}{4a} - k)\) and setting price \(c_y\).

**Proof.** It can be checked that by \(-\frac{c_y}{2a} < \frac{m}{2c_y} - k + \frac{c_y}{4a}\), I have \(\Pi^i_x \left( -\frac{c_y}{2a} \right) > 0\), and therefore it follows that maximizing \(\Pi_x (\delta_x)\) gives me the required first-stage action of firm \(x\). By the assumptions and the continuity of \(\Pi_x\) at \(\frac{c_y}{2a} - k\), I only need to maximize \(\Pi_x\) over the intervals \(\left[\frac{c_y}{2a} - k, \frac{m}{2c_y} - k + \frac{c_y}{4a}\right]\) and \(\left[\frac{m}{2c_y} - k + \frac{c_y}{4a}, \infty\right]\).\(^\text{22}\) It can be verified that \(\Pi^i_x\) is maximized at \(\delta_x = -\frac{c_y}{2a}\) within \(\left[\frac{c_y}{2a} - k, \frac{m}{2c_y} - k + \frac{c_y}{4a}\right]\) and \(\Pi^{ii}_x\) at \(\frac{m}{2c_y} - k + \frac{c_y}{4a}\) within \(\left[\frac{m}{2c_y} - k + \frac{c_y}{4a}, \infty\right]\) by the assumptions, which completes the proof by considering \(\Pi_x (\delta_x), \delta^*_y (\delta_x)\) and \(\Pi_y (\delta_y)\). The appropriate price is determined by the results in Propositions 1 and 2.\(^\text{23}\)

Proposition 4 demonstrates the situation where the low cost firm’s profits from driving the high-cost firm out of the market are greater than the profits from choosing a strategy to

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\(^{21}\)As is evident in the analysis of the duopolist’s game, there are various other equilibrium situations that arise, given certain conditions. The set of full derivations is available from the authors upon request.

\(^{22}\)\(\Pi^v_x (\delta_x)\) is negative in region (v).

\(^{23}\)A more general proof is available from the authors.
share the market with that firm. The profit functions take the form

\[ m - \frac{m}{c_y} c_x - a \left( \frac{m}{2c_y} - k + \frac{c_y}{2a} \right) > \frac{m}{2} \left( k - \frac{c_x}{2a} - \frac{c_y}{2a} \right) c_x - a \left( \frac{c_x}{2a} \right)^2. \] (1.9)

When it is profitable, the low-cost firm will advertise to increase the threshold just enough, and will set a price equal to \( c_y \), so that the high cost firm will not enter the market. Thus, the low-cost firm receives all income \( m \) and though production increases, will not pay enough in costs to justify switching to the market-sharing strategy. Note that for this result to hold, the income to production cost ratio must be high, especially relative to the threshold.

According to this model of preferences, information that the threshold is high suggests that the consumer has a low probability of achieving the threshold. Thus, the consumer will choose the good which will yield the highest chance of obtaining the favorable outcome.

This result fits nicely with the story that messages about the threshold level can influence demand. If humans still respond to cues that inform them about the current state of health, survival, and reproduction, it should not be surprising that advertisers incorporate related content into their ads. Furthermore, use of content related to health, survival, and reproductive success places the product in the context of these threshold-type situations. Since realizations of good health, survival, and reproductive success are often binary in nature—achieved or not—I think of realizing favorable outcomes as achieving a threshold level of quality. Environmental, situational, or other cues about the state of nature trigger behavioral responses that have developed over the thousands of years of natural selection (see Konner, 2002). Firms recognize this behavior and under a proper set of parameters, a firm will advertise a high-threshold state. From the firm’s perspective, it is only reasonable to send positive product messages. Thus, I interpret advertisements as presenting two distinct
states, one in which the threshold is high and the payoff is very uncertain, and one in which the product is associated with achieving the threshold.\footnote{This is consistent with the theory presented in Mullainathan, Schwartzstein and Schleifer (2008). The analogies in the model can be thought of as situations where product consumption is associated with achieving the threshold.}

To cite one stark example, an advertisement which aired in 2002 for the McDonald’s Mighty Kids Meal (described in Smith, 2004) shows a group of children playing basketball. One of the children suddenly freezes and his friends carry him inside his house, set him on a couch, and set a fast food meal directly in front of him. Miraculously, the child jumps back to full activity as he rapidly consumes the meal. Before product consumption, the child’s state of nature was serious—the threshold was very high. In this advertisement, the states of nature represented are: 1) the fact that good health is never certain and 2) consumption of this particular meal is associated with the favorable outcome of good health. The power of such an appeal is informed by knowledge of nutritional anthropology: in the pre-industrial world in which humans evolved, micronutrient deficiencies were not uncommon. A child in that world witnessing such a scene—in which a specific food item appears to cure a severe illness—would do well to incorporate said food item into his diet, enthusiastically. The high threshold is suggested through uncertain health and the favorable outcome, associated with good health, is associated with consumption of the McDonald’s Mighty Kids Meal.

I have reason to expect that advertisers employ different strategies for content use when targeting different audiences. To be specific, the types of situations children and adults faced in the pre-industrial era were different then, and still are today. For example, children develop dietary preferences and tastes for foods by observing dietary habits of
family and friends (Smith, 2004). Also, younger children are not expected to be influenced by associations between the product and romance. Thus, I expect to see less content related to courtship in children’s advertisements compared to the frequency of the same content in advertisements for general audiences.

1.4 Data and Evidence

In order to study the content in advertisements, I collected a convenience sample of 370 unique nationally broadcast television advertisements.25 A general description of the sample is provided in Table 2.0.26 Although the sample is weighted towards children’s programs in terms of time, there were fewer unique advertisements during these programs.

To study content in the sample of advertisements, I performed a content analysis based on a pre-determined list of content categories. I generated an initial category list after viewing a set of out-of-sample advertisements, with only minor adjustments thereafter. Several of the categories relate to direct information such as price, product features, and verifiable claims about product quality.27

25 I omitted advertisements that were limited to regional audiences because I believe they are less likely to include sophisticated (and hence effective) marketing techniques. Also, the sample omits movie trailers, movie advertisements, and video game advertisements since ads for these goods are of a much different nature than the ads of the other goods in the sample. Specifically, I omitted advertisements which did not include a potential product user.

26 I recorded ads during children’s programming, as well as programs aimed at a more general audience, on various dates in June and July, 2007.

27 Refer to the appendix for the specific descriptions I used when coding for content.
I also defined categories which captured content related to thresholds: health, survival, and finding a mate, which I will refer to as courtship. For the health threshold, I documented which advertisements contained content that associated the product with obvious improvements in health or well-being. As an example, a Coors Light advertisement in the sample begins with the view of a crowded street in the middle of a sweltering hot day. Traffic was very slow and people appeared lethargic and unhappy. Suddenly, a train barrels through an open lane in the street followed by a wake of snow that transforms into cans of Coors Light. Party-like music fills the streets and an immediate shift in well-being is demonstrated as the characters joyfully cheer and dance—the opportunity has been signaled. Similar to the McDonald’s advertisement described above, this ad demonstrates a contrast in states of the world that depend on product consumption. The threshold payoff is markedly improved health, which is achieved with product consumption.

Content associated with survival typically demonstrates life-threatening situations when a character (or implied character) in the advertisement does not consume the product. For example, two advertisements in the sample for Ford F-150 trucks emphasize the 4-star crash rating awarded to these trucks. Also, images of the truck smashing into a wall accompany safety rating declarations. This imagery signals product safety by exposing safety features. The opportunity presents itself as safe transportation when travel in other vehicles is dangerous. In other words, the threshold is high when not traveling in a Ford F-150.28

Courtship-related content associates romantic relations with product use. For exam-

28 Recall region $A^0$, the “death zone.” When $k$ is high, this region expands over a greater set of feasible combinations of $x$ and $y$, which results in a greater probability of not achieving the threshold.
ple, an advertisement for a buy-one-get-one half off sale at Payless Shoes stores shows two attractive female models wearing Payless shoes as they walk through an outdoor shopping area. They step onto an escalator and exchange glances with a stylishly dressed male model on an adjacent escalator heading the opposite direction. The male model jumps over the escalator rails onto the other escalator and the two ladies look at each other and smile. At this point, the narrator says, “Before you know it, it’s gone,” explicitly referring to the current sale. The male model then exchanges glances with another attractive female wearing Payless shoes, but headed on the escalator he previously abandoned. He looks ahead at the two he initially intended to follow and looks back at the other as she heads off the escalator and smiles. The explicit meaning of this statement is to notify viewers of the limited time offer. The imagery, however, seems to suggest that valuable romantic opportunities are available to consumers of Payless Shoes, but that success is far from certain. The narration emphasizes that the sale is limited and delays can result in missed romantic opportunities.

Table 2.1 provides a description of the threshold themes and factual content. See the appendix for more detailed descriptions.

Tables 1.2 and 1.3 report estimated frequencies and confidence intervals for specific types of content during children’s programs and programs for a general audience. I will first discuss the results in the final column of each table that show the overall frequencies of specific content for advertisements targeted at children (Table 1.2) and advertisements targeted at a general audience (Table 1.3).

I report results for general factual content and then divide that content into is separate components of price, features, and verifiable quality claims. Similarly for threshold relate themes, I report general use of such themes and then report more specific threshold-related
categories of health, survival, and courtship. The other columns in tables 1.2 and 1.3 include frequencies for content in advertisements for specific product groups.

To begin with, it is interesting to recognize the infrequent use of price in advertisements. Information about price occurred in 8% of all ads aimed at children and 15% of all ads aimed at a more general audience (the difference is statistically insignificant). Why advertisers do not reveal a product’s price more often is not the focus of this paper, though Anderson and Renault (2006) provide reasons why advertisers may have incentive to not disclose certain information in an advertisement. There could also be contractual or strategic reasons not to reveal prices. The theory in Anderson and Renault (2006), however, does not specify which product information the advertiser will choose to disclose.

Although product price is not frequently included in advertisements, there is a substantial amount of other factual information. The data reveal that most of this factual information comes in the form of product features, i.e., observable product characteristics whether explicitly stated or shown via screen shots. For all product types, product features occur in 75% of all ads targeted at children and almost 70% of all ads targeted at a more general audience. This result also reveals that 25% of all ads targeted at children and 30% of all ads targeted a more general audience lacked any information about product features or price.

A very interesting fact in the data is that there are few verifiable quality claims. I

\[29\] I calculated frequencies by counting whether a specific type of content occurred in an advertisement. For the factual content and threshold-related theme general categories, if two of the specific categories were used, I still report that the general category was triggered, and not how many times it was triggered in an advertisement.
define verifiable quality claims as claims about the product quality that could be falsified through independent testing. I found that while 3% of all advertisements aimed at children included verifiable quality claims, they appeared in 20% of all advertisements aimed at a more general audience. Furthermore, the estimated difference in frequencies of verifiable quality claims in all advertisements for children and general audiences is significant at the 95% confidence level. This makes sense because children are probably less concerned than adults about quality, or are less likely to think about the expected future benefits signaled by a quality statement.

Tables 1.2 and 1.3 also report content frequencies for specific product types. The auto, food and beverage, and toys product categories are the most narrow product categories so they likely yield the least amount of bias in estimates for the probability of content frequency.\textsuperscript{30} Thus, I will focus the discussion on these three product categories.

In food and beverage advertisements that occurred during programs for general audiences, 12% of the advertisements conveyed price information whereas 3% of food and beverage advertisements for children included price information. In the same product group, features occurred in 64% of ads for children and 66% of ads for general audiences. Once again in the same product group, verifiable quality claims occurred 27% of the time, whereas 50% of the food and beverage advertisements during children’s programs had verifiable quality claims. I found this difference to be statistically significant.

\textsuperscript{30}There was only 1 auto advertisement in ads targeted at children and 1 toy advertisement in ads targeted at a more general audience, thus I omit auto product category from Table 1.2 and I omit the toy product category from Table 1.3.
In the automobile product category (general audience), 17% of the advertisements had price information, 72% had information about product features, and 36% had verifiable quality claims. In advertisements for toys (children), I found that 11% had price information, all of them included information about product features, and none of them had verifiable quality claims.

I also found considerable evidence that advertisers use threshold-related themes. These themes occurred in 72% of all ads targeted at children and 60% of all ads targeted at adults. Refer to the health and survival situations in the Coors Light and Ford F-150 advertisements. In both cases, the situation suggested a high threshold and that product use would ensure the threshold is achieved. Across all product types, content directly related to health surfaced in 66% of ads targeted at children and 49% of ads targeted at general audiences. This difference is statistically significant. Survival-related content appeared in only 8% of all children’s ads and 6% of all ads for general audiences. In the Payless Shoes advertisement, the threshold for courtship increased as the chance to obtain an attractive mate seemed to slip away. In the sample, content directly related to a high courtship threshold occurred in 7% of all ads targeted at children and 16% of all ads targeted at general audiences. This difference is also statistically significant. It makes sense that advertisers use more thematic content in advertisements for children since children are probably influenced more by imagery and situational-type messages.

Similar to the results for all product types, I found repeated use of content related to high thresholds in advertisements for separate product types. The most prominent use occurred in food and beverage advertisements. In this product group, the health-related theme occurred in 79% of advertisements for children compared to 64% of ads which appeared
during programs for general audiences. In the same product group, survival-related content occurred in 5% of the ads for children and 2% of the ads for a general audience. Once again in the same product group, 8% of children’s advertisements had courtship-related content while 20% of ads for a general audience had this type of content.

In advertisements for automobiles and related products (general audience) I found health-related themes in 36%, survival-related themes in 11%, and courtship-related themes in 6% of the advertisements. In toy advertisements (children), 61% had a health-related theme, 9% had a survival-related theme, and 5% had a courtship-related theme.\(^{31}\)

In the samples for both target audiences, I found statistically significant evidence that threshold-related content occurred more frequently in food and beverage advertisements than for all product types. In children’s advertisements, I also found that factual content in food and beverage advertisements occurred less frequently than for all product types. Furthermore, I found that threshold-related content in children’s food and beverage advertisements occurred with greater probability than in the aggregate, all products group. In advertisements for general audiences, I found that threshold-related content occurred less frequently (statistically) in advertisements for automobiles and related products than for all products. On the other hand, threshold-related content occurred more frequently (statistically) in food and beverage advertisements for general audiences relative to the probability of threshold-related content in all ads for general audiences. I suggest that these results point

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\(^{31}\)The difference between the probabilities of verifiable quality statements in food and beverage advertisements for children and general audiences is statistically significant. This is the only statistically significant result for differences in content frequency in product types for children and general audiences. It is probably due to small sample sizes.
Economic theories of advertising predict the usefulness of factual information to increase sales. I also think that threshold-related content has an influence on behavior, and thus, there is strategic use for it. It would make sense, therefore, to compare the estimated probabilities of factual content to threshold-related content. I do this by placing the difference in probabilities for the two types of content on a scale from -1 to 1. A negative value represents a numerically greater probability of threshold content, and a positive value represents a numerically greater probability of factual content. The idea is that the farther apart the probabilities are spaced, the more reason to believe that threshold-related content is strategically used.

In children’s advertisements, I find that advertisements for food and beverage and services groups contain more threshold-related content, but the difference is statistically significant at the 10% level of confidence only for the food and beverage category. In advertisements for a general audience, the scale reveals that advertisements for this target audience contain greater frequencies of factual content, and the only statistically significant difference is for the services category. When I compared the two scales, I found that there is a greater spread in the differences of content type in children’s advertisements. Also, a greater spread between threshold-related content and factual content in children’s advertisements suggests a greater use of this content in advertisements for children.

In summary, the sample reveals frequent use of content related to thresholds. Repeated use of this content suggests that advertisements portray the “opportunity” to obtain a desirable outcome. Furthermore, the advertisements also suggest that obtaining the desir-
able outcome is far from certain. Yet, the favorable outcome of obtaining the threshold is associated with product consumption.

1.5 Conclusion

In order to provide economic rationale for the use of thematic-type content in television advertisements, I propose a model of consumer and producer behavior where information about threshold payoffs induces sudden shifts in demand. In the model, quality thresholds in consumer preferences lead to risk averse behavior when the threshold is low and risk-taking behavior when the threshold is high. I then derive demand functions that are discontinuous in the threshold \( k \), so a high \( k \) will result in a shift in product demand. Given these demand functions, and under certain conditions, a low-cost firm has the incentive to advertise a high threshold and associate a specific product with achieving the threshold. When these thresholds are placed in the context of human evolutionary history, I are able to provide a more compelling predictive theory for the use of the psychological content in advertisements.

The theory I present helps explain the repeated use of certain threshold-related themes in television advertisements. These themes appear to be designed to convey the message that there is a low probability of achieving a threshold level of quality in the current state of nature, but that the opportunity to achieve that threshold is on the horizon. Thus, advertisers depict a stark contrast between the current, high-threshold, state of nature and the potential, with product consumption, favorable state of nature.

Our findings represent only a small step in the direction of understanding the mechanisms through which thematic content can affect consumer behavior. As a result, there are
numerous possibilities for further research. For example, a natural extension of this work would be to conduct experiments where the effects of certain types of content are measured. It would also be interesting to conduct an empirical study of firm behavior that tracks use of specific content in advertisements and corresponding sales data. Unfortunately, data of this sort can be very difficult to obtain. Nonetheless, the frequent use of specific types of content in television advertising begs for a more formal economic theory of advertising content.
Figure 1.1: Five Regions
Figure 1.2: Indifference Curves \( (k = 1) \)
Figure 1.3: Optimal solutions for $x$ and $y$ as functions of $k$
<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>General Audience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Advertisements</td>
<td>155</td>
<td>215</td>
<td>370</td>
</tr>
<tr>
<td>Programming Hours</td>
<td>25</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>Content Type</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factual Content</td>
<td>Declarations of the product’s price; product characteristics; verifiable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>quality claims</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Obvious improvements in health and/or well being when a character sees or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hears about the product.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survival</td>
<td>Negative consequences for those not using the product.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Courtship</td>
<td>Obviously romantic relationship between a male and female character, one of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>which uses the product.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.3: Content Frequency in Advertisements by Product Type During Programming for Children

<table>
<thead>
<tr>
<th>Content</th>
<th>Food / Beverage</th>
<th>Household Products</th>
<th>Services</th>
<th>Toys</th>
<th>All Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual</td>
<td>0.68</td>
<td>0.89</td>
<td>0.52</td>
<td>1**</td>
<td>0.77</td>
</tr>
<tr>
<td>Price</td>
<td>0.03</td>
<td>0.21</td>
<td>0.08</td>
<td>0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>Features</td>
<td>0.64</td>
<td>0.89</td>
<td>0.52</td>
<td>1**</td>
<td>0.75</td>
</tr>
<tr>
<td>Verifiable Quality</td>
<td>0.05*</td>
<td>0.05</td>
<td>0.04</td>
<td>0.00**</td>
<td>0.03*</td>
</tr>
<tr>
<td>Thresholds</td>
<td>0.83</td>
<td>0.68</td>
<td>0.56</td>
<td>0.66</td>
<td>0.72*</td>
</tr>
<tr>
<td>Health</td>
<td>0.79</td>
<td>0.63</td>
<td>0.44</td>
<td>0.61</td>
<td>0.66*</td>
</tr>
<tr>
<td>Survival</td>
<td>0.05</td>
<td>0.16</td>
<td>0.12</td>
<td>0.09</td>
<td>0.08</td>
</tr>
<tr>
<td>Courtship</td>
<td>0.08</td>
<td>0.16</td>
<td>0.04</td>
<td>0.05</td>
<td>0.07*</td>
</tr>
<tr>
<td>Sample Size</td>
<td>66</td>
<td>19</td>
<td>25</td>
<td>44</td>
<td>155</td>
</tr>
</tbody>
</table>

I omitted the auto product category from this table because the sample had only one ad of this type during children’s programs. The “All Products” column, however, includes the auto advertisement. * Statistically different from the estimated frequency of content during programs for general audiences. ** Since the estimated frequency is 1, I cannot estimate if there is a difference between this frequency and the frequency for content during programs for general audiences.
Table 1.4: Content Frequency in Advertisements by Product Type During Programming for General Audiences

<table>
<thead>
<tr>
<th>Content</th>
<th>Food / Household</th>
<th>Products</th>
<th>Services</th>
<th>All Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factual</td>
<td>0.75</td>
<td>0.71</td>
<td>0.80</td>
<td>0.68</td>
</tr>
<tr>
<td>Price</td>
<td>0.17</td>
<td>0.12</td>
<td>0.19</td>
<td>0.13</td>
</tr>
<tr>
<td>Features</td>
<td>0.72</td>
<td>0.66</td>
<td>0.68</td>
<td>0.66</td>
</tr>
<tr>
<td>Verifiable Quality</td>
<td>0.36</td>
<td>0.27*</td>
<td>0.17</td>
<td>0.08</td>
</tr>
<tr>
<td>Thresholds</td>
<td>0.42</td>
<td>0.71</td>
<td>0.59</td>
<td>0.58</td>
</tr>
<tr>
<td>Health</td>
<td>0.36</td>
<td>0.64</td>
<td>0.50</td>
<td>0.37</td>
</tr>
<tr>
<td>Survival</td>
<td>0.11</td>
<td>0.02</td>
<td>0.04</td>
<td>0.11</td>
</tr>
<tr>
<td>Courtship</td>
<td>0.06</td>
<td>0.2</td>
<td>0.17</td>
<td>0.18</td>
</tr>
<tr>
<td>Sample Size</td>
<td>36</td>
<td>59</td>
<td>81</td>
<td>38</td>
</tr>
</tbody>
</table>

I omitted the toys product category from this table because the sample had only one toy advertisement during programs for a general audience. The “All Products” column, however, includes toy advertisement.

* Statistically different at the 95% confidence level from the estimated frequency of content during children’s advertisements.
CHAPTER 2. EVIDENCE OF EXCESS DEMAND IN
TELEVISION ADVERTISEMENTS

Abstract

The use of advertising to shift consumer demand has been studied in various contexts. Economic studies of advertising tend to ignore content, yet content can have impacts on consumer behavior. In this paper, I show how contextual messages about excess demand in television advertisements increase demand for a product. In order to do this, I first show that when there is uncertainty regarding product availability, a consumer has the incentive to store a consumption good in the current period. As a result, total purchases of that good increase in the current period. Given this behavior, a producer has a strategic motive to influence perceptions about product uncertainty. Television advertisements are one way in which a producer can influence this perception and in a content analysis, I document the prevalence of messages related to product scarcity.
2.1 Introduction

Black Friday, the friday after Thanksgiving, is a day known for its big sales and extreme behavior. Shoppers line up in the very early hours of the morning to capture the best deals. Once the doors open, the stampede begins as shoppers fight their way to obtain their discounted good. Such extra-market activity can lead to serious injury, and even death.\textsuperscript{32} While these discount prices increase consumer welfare, the extreme behavior associated with this big sale event can be interpreted as excess demand. The current sale price does not have sufficient supply to meet demand so extra-market behavior, such as a stampede, occurs.

Given this behavior, it is not hard to believe that perceptions regarding the availability of a good, or even a price, can potentially lead to extra-market activity. Perceptions about product availability can be affected by word of mouth, through advertisements ("while supplies last"), or even through observed behavior. Thus, influencing perceptions that excess demand for a product may occur can be a powerful strategy.

My objective in this research is to demonstrate that content in television advertisements related to excess demand can affect perceptions about product uncertainty, and thus lead to increases in demand. First, I develop a model of consumer behavior and demonstrate that increases in uncertainty regarding the availability of a product in a future period results in an increase in demand for that product in the current period. When there is greater uncertainty about product availability in a future period, the consumer purchases more of a storable good

\textsuperscript{32}The July 8, 2010 electronic issue of USA Today relates a story of how a stampede at a Wal-mart on Black Friday in 2008 resulted in the death of a temporary employee.
in the current period in order to smooth consumption across the two periods. Since purchases of the storable good increase in the current period, a producer has an incentive to influence the perception the product will be more scarce in the future period.

I then relate this analytical result to advertisements through the learning by observation bias that is prevalent in human psychology. Learning by observation can be a costless way to obtain information, but the information is not always perfect. Regardless, I assume that the consumer in my model learns by observation and thus takes the messages of excess demand that occur in television advertisements, e.g., characters fight over the advertised product, as relevant to the real world. As a result, the consumer’s perception about the future state of the world is affected and the consumer purchases more of the advertised product. I then document the prevalence of this type of content in a sample of advertisements.

2.2 Literature Review

The way in which advertising shifts demand has been studied in many contexts. Two very influential papers, Stigler and Becker (1977) and Becker and Murphy (1993) assume that advertisements and the respective good are complements, thus increases in advertisements increase product demand. Dorfman and Steiner (1954) and Johnson and Myatt (2006) study how advertising changes the shape of demand, and can even rotate demand, based on the type of information in the advertisements.

These models, however, do not provide any explanation for the stark messages of excess demand evident in television advertisements. When I refer to messages of excess demand, I refer to content that shows characters fighting over the advertised product, and characters
going to great lengths to obtain the product. This type of content can affect consumer
demand through the learning by observation bias in psychology. In a very influential paper,
Bikhchandani, Hirshleifer and Welch (1992) show how consumers can rely on the behavior of
others, more so than their own private information, and become a part of the new fad. On
a similar note, Brekke and Rege (2007) assume that consumers are unable to differentiate
between fictitious characters and real people in advertisements, thus, they believe what they
see on television advertisements. As a result, what may have appeared to be uninformative
advertisements are useful for this reason.

I build on the advertising literature by demonstrating how influencing perceptions
about product uncertainty can have strategic importance for producers. In this paper, I
argue that perceptions about product uncertainty can be affected by content in television
advertisements that directly relate to excess demand. This relies on the assumption that
consumers learn from the behavior of others and that cues relating to excess demand are
effective since they are a part of human evolutionary history.

2.3 Model

The main objective in this study is to understand how messages in advertisements
related to excess demand can affect consumer behavior. I approach this objective by studying
the behavior of a rational consumer that faces the possibility of a supply shock in the second
period of a two period model. I then examine how changes in the probability of the supply
shock affect consumption decisions in both periods. Finally, I discuss the way in which
advertising can affect the subjective belief about the future states of the world, and thus
affect consumer demand.

2.3.1 A Model of Consumer Behavior when Supply is Uncertain

I assume that a representative consumer lives for two periods and in each period chooses specific amounts of goods $x$ and $y$ for consumption. In the first period, the amount of good $x$ consumed is $x_1$ and the amount of good $y$ consumed is $y_1$. I assume that good $y$ is a numeraire good so its price is 1. In the first period, the price of good $x$ is $p$ and the consumer receives an exogenous amount of income equal to $m$. In this period, the consumer is also able to store some of good $x$ and the amount stored is $s$. Thus, the total amount of good $x$ purchased in period 1 is $x_1 + s$. In what follows, I will explain the uncertainty the consumer faces in the second period, so the storage good acts as a savings vehicle to smooth consumption over time.

In the second period one of two different states of nature will occur. I refer to the first state of nature as the non-scarce state and it occurs with probability $\phi$. In this state of nature, the amount of good $x$ consumed is $x_{2N}$ and the amount of good $y$ consumed is $y_{2N}$ (the subscript $N$ refers to the non-scarce state). Furthermore, in this state the amount of exogenous income and price of good $x$ are the same as in period 1 so if this state occurs with probability 1, the consumption decisions for $x$ and $y$ would be identical to those in the first period, i.e., if $\phi = 1$ then $x_1 = x_{2N}$ and $y_1 = y_{2N}$.

A second state of nature, the scarce state, occurs in the second period with probability $1 - \phi$. In this state of nature, exogenous income is the same as in the first period, but the
price of good $x$ has increased to $\tilde{p}$.\textsuperscript{33} The amount of good $x$ consumed is $x_{2S}$ and the amount of good $y$ consumed is $y_{2S}$ (the subscript $S$ refers to the scarce state). Since the price of good $x$ is higher in this state of nature, $x_1 > x_{2S}$. Since this state has a positive probability of occurring, the consumer has an incentive to store good $x$ in the first period and carry it into the second period to counteract, at least in part, the decrease in consumption that is associated with the higher price in the scarce state.

The consumer’s preferences for goods $x$ and $y$ are represented by strictly concave and twice continuously differentiable functions $u$ and $v$, respectively, and these functions are the same in both periods. The strict concavity of each function results in increasing utility but diminishing marginal utility in both goods. It also ensures that the sum of utilities across both periods still has properties of increasing utility and diminishing marginal utility. Also, second period consumption is discounted by some discount factor $\beta < 1$.

The consumer’s decision problem is to maximize the sum of expected utility across the two periods by choosing $x_1$ and $y_1$ in the first period and $x_{2N}$ and $y_{2N}$ or $x_{2S}$ and $y_{2S}$, depending on the state of nature that occurs. The maximization problem is

$$\max_{x,y,s,\hat{x},\hat{y},\tilde{x},\tilde{y}} \ u(x_1) + v(y_1) + \phi \left( u\left(x_{2N} + s\right) + v\left(y_{2N}\right)\right) + \left(1 - \phi\right) \left( u\left(x_{2S} + s\right) + v\left(y_{2S}\right)\right)$$

s.t.

$$m = p(x_1 + s) + y_1; \ m = px_{2N} + y_{2N} \text{ or } m = \tilde{p}x_{2S} + y_{2S}. \tag{2.1}$$

\textsuperscript{33}This price increase can correspond to a reduction in supply.
The first order conditions of the maximization problem (assuming interior solutions) are

\[
\frac{\partial L}{\partial x_1} = \frac{\partial u(x_1)}{\partial x_1} - p\lambda_1 = 0,
\]

\[
\frac{\partial L}{\partial y_1} = \frac{\partial v(y_1)}{\partial y_1} - \lambda_1 = 0,
\]

\[
\frac{\partial L}{\partial x_{2N}} = \phi \frac{\partial u(x_{2N}+s)}{\partial x_{2N}} - p\lambda_2 = 0,
\]

\[
\frac{\partial L}{\partial y_{2N}} = \phi \frac{\partial v(y_{2N})}{\partial y_{2N}} - \lambda_2 = 0,
\]

\[
\frac{\partial L}{\partial x_{2S}} = (1 - \phi) \frac{\partial u(x_{2S}+s)}{\partial x_{2S}} - \tilde{p}\lambda_2 = 0,
\]

\[
\frac{\partial L}{\partial y_{2S}} = (1 - \phi) \frac{\partial v(y_{2S})}{\partial y_{2S}} - \lambda_2 = 0,
\]

\[
\frac{\partial L}{\partial s} = \phi \frac{\partial u(x_{2N}+s)}{\partial x_{2N}} + (1 - \phi) \frac{\partial u(x_{2S}+s)}{\partial x_{2S}} - p\lambda_1 = 0.
\]

(2.2)

When I totally differentiate the first order conditions I can derive the comparative static results for the consumer’s decision problem. The first comparative static results I am interested in are \( \frac{\partial s^*}{\partial \phi}, \frac{\partial x_1^*}{\partial \phi}, \) and \( \frac{\partial y_1^*}{\partial \phi}, \) where the superscript \( ^* \) means the variable is the optimized amount. The signs of these results are\(^{34}\)

\[
\frac{\partial s^*}{\partial \phi} > 0, \quad \frac{\partial x_1^*}{\partial \phi} > 0, \quad \frac{\partial y_1^*}{\partial \phi} < 0
\]

(2.3)

Since the consumer chooses an amount of good \( x \) to store in the first period, the consumer must substitute away from good \( x_1^* \) and/or good \( y_1^* \) to finance \( s \). According to the comparative static results, a decrease in \( \phi \), i.e., an increase in the probability that the scarce state of nature will occur, will result in a decrease in both \( x_1^* \) and \( y_1^* \) and an increase in \( s^* \). Thus, the consumption smoothing behavior of the consumer leads to a decrease in \( x_1^* \) and \( y_1^* \) to finance purchases of \( s \) when \( \phi \) increases. Furthermore, since both \( x_1^* \) and \( y_1^* \) decrease as \( \phi \) decreases, the magnitude of \( \frac{\partial s^*}{\partial \phi} \) is greater than the magnitude of \( \frac{\partial x_1^*}{\partial \phi} \) or \( \frac{\partial y_1^*}{\partial \phi} \). This is

\[^{34}\text{The proofs of the comparative static results are in the appendix.}\]
important because this shows that the total amount of good $x$ purchased in the first period increases, despite the decrease in $x^*_1$. Later I will discuss the strategic importance of this result for producers.

The comparative static results for consumption decisions in the second period are

$$\frac{\partial x^*_N}{\partial \phi} > 0, \quad \frac{\partial y^*_N}{\partial \phi} < 0,$$

$$\frac{\partial x^*_S}{\partial \phi} > 0, \quad \frac{\partial y^*_S}{\partial \phi} < 0.$$  \hspace{1cm} (2.4)

These results demonstrate that a decrease in $\phi$ will result in a decrease of $x^*_2N$ and an increase in $y^*_2N$, or a decrease in $x^*_2S$ and an increase in $y^*_2S$. Since a decrease in $\phi$ leads to an increase in $s^*$, the consumer carries a greater amount of $s^*$ into the second period, relative to the case when $\phi$ is smaller, so that the consumer can decrease $x^*_2N$ or $x^*_2S$ but offset that decrease with $s^*$. This frees up income for purchases of $y^*_2N$ or $y^*_2S$. Does this mean that $x^*_2N$ and $x^*_2S$ are inferior, since an increase in income—through the storage good—negative impacts the amount of both? The answer to this question relies on the idea that $s$ is strictly measured in units of good $x$. As a result, there is a trade off in both periods between consumption of good $x$ and the storage amount. Nonetheless, storage of the good is a substitute for $x$ in either period and so $x$ is not considered an inferior good.

### 2.3.2 The Effect of Advertising on Beliefs about Product Uncertainty

The analysis of consumer behavior when future supply of a storable good is uncertain demonstrates the importance of $\phi$ in affecting consumer demand for that good. This change in demand can have strategic importance for producers in at least two different ways. First of all, let $\phi$ be the consumer’s subjective belief about the future states of the world. Also, let
φ be a function of different types of information that could affect the consumer’s perception about φ. These types of information could include news reports, rumors, and I will propose advertising.

There are specific types of content in advertisements that, when considered in a market context, suggest situations of excess demand. I refer to such content as squabbles or situations where a character in the advertisement will go to great lengths to obtain the advertised product. These situations relate to extra-market activities that suggest product scarcity.

I propose that this type of content affects consumer demand through the learning by observation of others mechanism. There is a good deal of information a consumer can collect when observing the behavior of other consumers, especially with regards to a consumption good. Such behavior is evident in everyday life; information can flow via word of mouth or observing the satisfaction a product brings to a consumer. Bikhchandani, Hirshleifer and Welch (1992) demonstrate that learning from others can potentially override private information and lead to fads. Thus, if the representative consumer learns from the behavior of others, then there is a good chance that the extra-market behavior in advertisements can affect a consumer’s belief about the future states of the world.

In addition, demonstrations of excess demand in television advertisements send messages that resonate deeply with the human psyche. Over the course of evolutionary history, there are many instances when survival depended on consumption of a very scarce resource. In the context of evolutionary history, if one were to view two people fighting for a particular item, it could easily be interpreted as excess demand for the product. Since these situations were very much a part of human evolution, I assume that these types of messages still affect consumer behavior. The way in which these messages affect consumer behavior is, as
the model demonstrates, to store the good in the current period since future availability is uncertain. Thus, a producer can increase the demand for a good in the first period by using messages in advertisements that suggest excess demand.

Increases in demand due to greater supply uncertainty are of strategic importance for producers in a second way; producers may choose to directly affect $\phi$ instead of only affect perceptions regarding $\phi$. Deo and Corbett (2009) show that under certain conditions, increases in uncertainty surrounding the influenza vaccine can lead to increases in demand, thus, there are strategic implications for threatening to restrict supply. For such a threat to be credible, however, the game must be a sequential game, and my current model is only a two period model. Nonetheless, I do find evidence for such behavior in advertisements. Limited time price discounts, such as sales on Black Friday, can lead to extra-market behavior and potentially increase demand. These sales offers appear in advertisements, as well as messages of limited supply, e.g., “while supplies last.” It would be very interesting to study the game where a producer periodically restricts supply, and thus creates uncertainty regarding the availability of its product.

2.4 Data

In order to study the content in advertisements, I collected a convenience sample of 370 unique nationally broadcast television advertisements.\textsuperscript{35} A general description of my sample

\textsuperscript{35}I omitted advertisements that were limited to regional audiences because we believe they are less likely to include sophisticated (and hence effective) marketing techniques. Also, my sample omits movie trailers, movie advertisements, and video game advertisements since ads for these goods are of a much different nature than the ads of the other goods in the sample. Specifically, I omitted advertisements which did not include
is provided in Table 2.0. Although the sample is weighted towards children’s programs in terms of time, there were fewer unique advertisements during these programs.

I analyzed the content in this sample by generating categories that represent specific themes. The themes of interest are those that relate to limited time offers (discount prices), product availability, and excess demand, though content related to excess demand is of most interest here. Table 2.1 lists the specific definitions I used when determining whether content could be counted as limited time offers, product availability, or excess demand.

The content that suggests excess demand is found in situations where characters fight over a product, perform outrageous acts in order to obtain the product, or there are pictures of fruit in the advertisement. I coined the term “squabble” to signify the situation where characters fight over a particular product. An excellent example of this category is from a Kia advertisement that aired during Super Bowl XLV (45). In this advertisement, a new Kia Optima went from being stolen by a police officer, to being captured by a billionaire, then taken by the water god Poseidon, beamed up by aliens in a UFO, and then time-warped to ancient America at the center of a Mayan ceremony. Even though this series of events is unrealistic, the message it sends is not. If a squabble were observed in the market place, a consumer would interpret it as a message of excess demand, and would adjust behavior based upon the new information.

---

36 I recorded ads during children’s programming, as well as programs aimed at a more general audience, on various dates in June and July, 2007.

37 In evolutionary history, ripe fruit was scarce in that it was only available for a short period of time, before it rotted. Thus, pictures of fruit can send a signal of product scarcity.
I also observed situations where a character performed outrageous acts in order to obtain the product. For example, in an advertisement for A1 Steak Sauce, a man licked up a drop of A1 Steak Sauce that landed on his bar-b-cue grill. This action suggests excess demand since the man willingly sacrificed his tongue to save a mere teaspoon of the steak sauce.

The first set of results for the content analysis are presented in Table 2.2. I find that about 27% of the advertisements in the sample have contextual content related to excess demand (as defined in Table 2.1). When I break this category into its smaller components, I find that 17% of the advertisements have content related to squabbles and characters going to great lengths to obtain the product. I also find that roughly 16% of the advertisements have content related to fruit. These results combine all targeted audiences and product types and thus hide the differences in content frequencies that result when the sample is broken into these groups. I will later divide the sample into target audiences and product groups.

Content that relates to limited time discounts and limited supply is much less frequent in the advertisements. 8.6% of the advertisements in the sample have content of this type, 5.9% have messages of price scarcity, and 3.8% have messages related to limited supply. Once again, these results hide the more specific results that correspond to specific audiences and product groups.

In Table 2.3 I divide the advertisement sample into advertisements that aired during children’s programming and advertisements that aired during programming for a more general audience. When I divide the sample in this manner, I find that content related to excess demand occurs in 35.5% of children’s advertisements, and this percentage is statistically different than the 21.4% of advertisements for general audiences that had content related to
excess demand. When I break the excess demand category into its respective components, I find that content related to the squabble occurred in 22.6% of the advertisements for children and in 13% of the advertisements for a more general audience, and this difference is statistically significant. Finally, instances of fruit occur in 23.9% of advertisements for children and in 10.2% of advertisements for general audiences and this difference is also statistically significant. When I divide the sample into target audiences, my results document a greater prevalence of messages related to excess demand in programs for children.

Table 2.3 also documents the frequency of content related to limited offers and product availability. It turns out that there is no statistical difference between the frequencies of this information in children’s advertisements and advertisements that occur during programs for a more general audience. This is interesting since economic theory would suggest a greater frequency of this type of content in television advertisements.

Next, I divide the sample into product types and report the results in Table 2.4. I find that advertisements for food and beverages has the highest frequency of content related to excess demand, 64.8%, compared to any other category. The squabble category occurs in 36.8% of food and beverage advertisements and instances of fruit occur in 44.8% of food and beverage advertisements.

Content related to induced scarcity occurs in 5.6% of food and beverage advertisements. Messages about limited time offers occur in 0.8% of advertisements and messages related to product availability occur in 5.6% of food and beverage advertisements. Once again, this content is much less prevalent that the content related to excess demand.

Table 2.4 reports that advertisements for household products are next in terms of frequency of excess demand content. Yet, the percentage is drastically lower at 13%. This
product category documents a greater prevalence of content related to limited time offers and product availability, though the frequencies are still below 20%.

Finally, Table 2.5 reveals that excess demand related content occurs in food and beverage advertisements during children’s programming at 74.2%. This percentage is bigger (and the difference is statistically significant) than the frequency, 54.2%, of excess demand related content that occurs in food and beverage advertisements during programs for a more general audience. In this product category, the squabble occurs in 45.5% of advertisements during children’s programs and in 27.1% of advertisements for a more general audience. Furthermore, instances of fruit occur in 54.5% of advertisements for children and in 33.9% of advertisements for a more general audience. This difference, and the difference in squabble frequencies, are both statistically significant at the 5% level.

The result that stands out most in this study is the prevalence of content related to excess demand that occurs in advertisements for food and beverages. Notice that all other product categories have lower frequencies for excess demand content. Advertisements for household products that air during programs for a general audience have content related to induced scarcity in 17.3% of the advertisements, but this result is still low relative to the 54.2% of food and beverage advertisements during programing for a general audience that have messages relating to excess demand. The frequency of induced scarcity related content in household product advertisements for children’s programs is similar to the frequencies in advertisements during programs for a more general audience. Again, the difference in the frequency between this content, 15.8%, and the frequency of excess demand related content in food and beverage advertisements, 74.2% is quite high.

This high prevalence of excess demand related content in food and beverage advertise-
ments suggests that this content is most useful in promoting these products relative to other products. This makes sense because food is a very important part of survival and over the course of evolutionary history, food scarcity forced migrations and killed many people. Thus, reactions to messages related to excess demand for food items could be more influential than messages relating to excess demand for other products. This points to a strategic motive for firms to use this type of content in television advertisements.

2.5 Conclusion

There are various types of content that can be included in an advertisement. In this study, I develop a model and demonstrate that content related to product scarcity can increase demand for a product. When a consumer stores a consumption good in order to smooth consumption over time, I show that uncertainty relating to the product’s availability induces the consumer to purchase more of the storable good in the first period. Given this behavior, a producer has the incentive to influence perceptions about the uncertainty of a product.

In order to relate this model to the effectiveness of television advertisements that suggest product scarcity through messages of excess demand, I assume that the consumer learns from the behavior of others and that the consumer responds to messages that would have suggested excess demand in an evolutionary context. This then leads to the result that one would expect excess demand related content to occur in television advertisements. In a sample of 370 television advertisements, I document the prevalence of excess demand related content, especially in food and beverage advertisements that occur during children’s
programs. The prevalence in food and beverage advertisements makes sense because of the importance of food in evolutionary history, and its importance for survival today.
## Table 2.1: Ad Sample by Target Audience

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>General Audience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique Advertisements</td>
<td>155</td>
<td>215</td>
<td>370</td>
</tr>
<tr>
<td>Programming Hours</td>
<td>25</td>
<td>13</td>
<td>38</td>
</tr>
</tbody>
</table>
**Table 2.2: Content Descriptions**

<table>
<thead>
<tr>
<th>Content Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess Demand</td>
<td>Characters fight over the advertised product; a character goes to great lengths to obtain the product; pictures of fruit</td>
</tr>
<tr>
<td>Induced Scarcity</td>
<td>Limited time offers; messages such as “while supplies last,” and “coming soon.”</td>
</tr>
<tr>
<td>Content</td>
<td>Frequency</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Excess Demand</td>
<td>101</td>
</tr>
<tr>
<td>Fight/Great Lengths</td>
<td>63</td>
</tr>
<tr>
<td>Fruit</td>
<td>59</td>
</tr>
<tr>
<td>Induced Scarcity</td>
<td>32</td>
</tr>
<tr>
<td>Price Scarcity</td>
<td>19</td>
</tr>
<tr>
<td>Product Scarcity</td>
<td>14</td>
</tr>
</tbody>
</table>
Table 2.4: Content Frequency in Advertisements During Programming for Children and General Audiences

<table>
<thead>
<tr>
<th></th>
<th>Children</th>
<th>General Audience</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess Demand&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.355</td>
<td>0.214</td>
<td>0.273</td>
</tr>
<tr>
<td>Squabble, Great Lengths&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.226</td>
<td>0.130</td>
<td>0.170</td>
</tr>
<tr>
<td>Fruit&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.239</td>
<td>0.102</td>
<td>0.159</td>
</tr>
<tr>
<td>Induced Scarcity</td>
<td>0.097</td>
<td>0.079</td>
<td>0.086</td>
</tr>
<tr>
<td>Price Scarcity</td>
<td>0.052</td>
<td>0.065</td>
<td>0.059</td>
</tr>
<tr>
<td>Product Scarcity</td>
<td>0.052</td>
<td>0.028</td>
<td>0.038</td>
</tr>
</tbody>
</table>

<sup>a</sup>: The difference between content frequency during children’s programming and programming for general audiences is statistically significant at the 5% level.
Table 2.5: Content Frequency in Advertisements for Specific Product Groups

<table>
<thead>
<tr>
<th></th>
<th>Autos</th>
<th>Food/Beverages</th>
<th>Household</th>
<th>Services</th>
<th>Toys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess Demand</td>
<td>0.000</td>
<td>0.648</td>
<td>0.130</td>
<td>0.048</td>
<td>0.089</td>
<td>0.273</td>
</tr>
<tr>
<td>Squabble, Great Lengths</td>
<td>0.000</td>
<td>0.368</td>
<td>0.110</td>
<td>0.032</td>
<td>0.089</td>
<td>0.170</td>
</tr>
<tr>
<td>Fruit</td>
<td>0.000</td>
<td>0.448</td>
<td>0.020</td>
<td>0.016</td>
<td>0.000</td>
<td>0.159</td>
</tr>
<tr>
<td>Induced Scarcity</td>
<td>0.081</td>
<td>0.056</td>
<td>0.170</td>
<td>0.032</td>
<td>0.067</td>
<td>0.086</td>
</tr>
<tr>
<td>Price Scarcity</td>
<td>0.081</td>
<td>0.008</td>
<td>0.140</td>
<td>0.016</td>
<td>0.067</td>
<td>0.059</td>
</tr>
<tr>
<td>Product Scarcity</td>
<td>0.000</td>
<td>0.056</td>
<td>0.060</td>
<td>0.016</td>
<td>0.000</td>
<td>0.038</td>
</tr>
</tbody>
</table>
### Table 2.6: Content Frequency in Advertisements for Specific Product Groups

<table>
<thead>
<tr>
<th></th>
<th>Autos</th>
<th>Food/Beverages</th>
<th>Household</th>
<th>Services</th>
<th>Toys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess Demand(^a)</td>
<td>0.000</td>
<td>0.742</td>
<td>0.053</td>
<td>0.040</td>
<td>0.091</td>
<td>0.355</td>
</tr>
<tr>
<td>Squabble, Great Lengths(^a)</td>
<td>0.000</td>
<td>0.455</td>
<td>0.000</td>
<td>0.040</td>
<td>0.091</td>
<td>0.226</td>
</tr>
<tr>
<td>Fruit(^a)</td>
<td>0.000</td>
<td>0.545</td>
<td>0.053</td>
<td>0.000</td>
<td>0.000</td>
<td>0.239</td>
</tr>
<tr>
<td>Induced Scarcity(^a)</td>
<td>0.000</td>
<td>0.106</td>
<td>0.158</td>
<td>0.080</td>
<td>0.068</td>
<td>0.097</td>
</tr>
<tr>
<td>Price Scarcity</td>
<td>0.000</td>
<td>0.015</td>
<td>0.158</td>
<td>0.040</td>
<td>0.068</td>
<td>0.052</td>
</tr>
<tr>
<td>Product Scarcity(^a)</td>
<td>0.000</td>
<td>0.106</td>
<td>0.000</td>
<td>0.040</td>
<td>0.000</td>
<td>0.052</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Autos</th>
<th>Food/Beverages</th>
<th>Household</th>
<th>Services</th>
<th>Toys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Audiences</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess Demand(^a)</td>
<td>0.000</td>
<td>0.542</td>
<td>0.148</td>
<td>0.053</td>
<td>0.000</td>
<td>0.214</td>
</tr>
<tr>
<td>Squabble, Great Lengths(^a)</td>
<td>0.000</td>
<td>0.271</td>
<td>0.136</td>
<td>0.026</td>
<td>0.000</td>
<td>0.130</td>
</tr>
<tr>
<td>Fruit(^a)</td>
<td>0.000</td>
<td>0.339</td>
<td>0.012</td>
<td>0.026</td>
<td>0.000</td>
<td>0.102</td>
</tr>
<tr>
<td>Induced Scarcity(^a)</td>
<td>0.083</td>
<td>0.000</td>
<td>0.173</td>
<td>0.000</td>
<td>0.000</td>
<td>0.079</td>
</tr>
<tr>
<td>Price Scarcity</td>
<td>0.083</td>
<td>0.000</td>
<td>0.136</td>
<td>0.000</td>
<td>0.000</td>
<td>0.065</td>
</tr>
<tr>
<td>Product Scarcity(^a)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.074</td>
<td>0.000</td>
<td>0.000</td>
<td>0.028</td>
</tr>
</tbody>
</table>

\(^a\): The difference between content frequency during children’s programming and programming for general audiences is statistically significant at the 5% level. I only present results for the statistical significance of the difference between frequencies of content between children’s programming and programming for a general audience for the food and beverage product category since this category has the most pronounced results.
Abstract

In 2003, the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) accelerated changes in income tax brackets scheduled to occur in later years. Between 2002 and 2003, IRS data for philanthropic organizations show an increase in average donation receipts. This increase in donations received is associated with a decrease in non-employee related fundraising expenditures and an increase in employee related fundraising expenditures. To understand this behavior, I develop a model of philanthropic organization behavior and estimate the parameters of the model. I find that the effectiveness of non-employee related fundraising expenses decreased after JGTRRA but that the effectiveness of employee related fundraising expenses increased after JGTRRA. This can help explain why employee related fundraising expenses increased after JGTRRA. I also find that a measure of organizational efficiency increased in its effectiveness to generate donations. Again, this can explain the substitution away from non-employee related fundraising expenses to employee related fundraising expenses.
3.1 Introduction

In the 1980’s, law makers passed several acts in an attempt to simplify the tax structure and decrease income tax rates for Americans. Two key acts passed in 1982 and 1986 and took effect in 1983 and 1987, respectively. While these acts were designed to decrease the tax burden on working citizens, the tax price of giving increased for those who itemized deductions. Given an increase in the tax price of giving, one would expect that those who itemize deductions would decrease their donations. Furthermore, one would also expect to see a spike in giving in 1982 and 1986 as those who itemize deductions take advantage of the lower price of giving before tax cuts took effect.

In an insightful article, Auten, Cilke and Randolph (1992) show that average donations did indeed spike in 1982 and 1986, though on average, donations did not decrease during the 1980’s. They also find that those in the highest income brackets decreased donations but those in lower brackets actually increased donations, so on average, donations did not change much at all. Given these results, it is natural to ask why donors did not behave as expected. The authors suggest that the actions of charitable organizations may have contributed to these interesting results. It is possible that charitable organizations adjusted behavior in order to incorporate the expected changes in donations, and thus, did not experience a drop in donations. The primary purpose of this study is to fill this gap by examining how a change in tax rates in 2003 affect the behavior of philanthropic organizations.

In 2003, the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) passed with an expectation that it would spur spending and speed up economic recovery. The law accelerated income tax rate cuts that were scheduled to occur in 2006. Summary statistics for
a small sample of philanthropic organizations demonstrate how donors responded. Prior to JGTRRA, these organizations received an average of $11.90 million each year while after the change in the tax law, the average increased to $15.60 million, a 31% increase in donations. While donations jumped from 2002 levels to higher levels in 2003, they continued to increase in the subsequent years. This increase in donations after JGTRRA passed is accompanied by a decrease in non-employee related fundraising expenditures and an increase in employee related fundraising expenditures.

Previous research on charitable donations has examined multiple avenues related to the effects of tax rate changes on individual donors. The effects of tax rate changes on philanthropic organizations, however, have not been examined. This side of the market for donations is important because these organizations focus on distributing resources to fund socially beneficial activities. Since decreases in tax rates affect donations, one must also ask how suppliers of charitable services, i.e., philanthropic organizations, respond.

In this paper, I present a model of a philanthropic organization where the objective is to maximize the discounted sum of program service expenditures, i.e., expenditures on the organization’s primary goals. In the model I include a market donations function that is affected by fundraising and employee expenses, that are both determined by the philanthropic organization, as well as factors exogenous to the philanthropic organization’s decision problem. Then I use a structural model to estimate the marginal effects and elasticities of fundraising and employee expenses on donations, as well as the the effects of an efficiency variable, and examine how JGTRRA led to the decrease in non-employee related fundraising expenses and the increase in employee related fundraising expenses.

To briefly summarize my results, I find that the marginal effect of non-employee related
fundraising expenses on donations prior to JGTRRA is $9.12, so an additional dollar spent on fundraising generates an additional $9.12 in donations. After JGTRRA, this effect drops to only generating an additional $3.52 for each dollar expended. This effect is in contrast to the increase in the efficacy of employee related expenses from a $9.57 increase in donations for each additional dollar spent to a $11.02 increase in donations. The non-employee related fundraising expenses are most likely less able to adjust in their ability to generate donations since they are mostly expenses for printing flyers, mailing flyers and contribution solicitation literature, airing television advertisements, and so forth. Employee related fundraising expenses, however, could be enhanced in effectiveness as managers train employees to be more efficient in soliciting donations.

The rest of the paper is structured as follows. In section 2, I will present previous literature that is relevant to the current study and demonstrates the contribution this study makes, as well as provide discuss the tax rate cuts associated with the Jobs Growth Tax Relief Reconciliation Act of 2003. In section 3, I present the model, some analytical results, and a functional form for the market donations function. In the section 4, I present the data I use in the empirical section. In section 5, I describe my estimation procedure and present my results. In section 6, I conclude and provide directions for further research.

3.2 Literature Summary

Although the focus of this research is on the behavior of philanthropic organizations, these organizations fall under the umbrella of organizations classified as nonprofit organizations. Therefore, I will present literature related to nonprofit organizations. Hansmann (1987)
describes the economic theories of nonprofit organizations as falling under two categories: theories regarding the role of nonprofit organizations and theories regarding the behavior of nonprofit organizations. Theories regarding the role of nonprofit organizations in a market economy explain why, and how, nonprofit organizations function in the market place. Previous literature that deals with the role of nonprofit organizations include the gap these organizations fill in response to non-responses by private markets and government failures to provide certain goods or services to smaller populations of voters (Weisbrod, 1986), responses to informational asymmetries (Easley and O’hara, 1986; Krashinsky, 1986; Rose-Ackerman, 1996), means for entrepreneurs and managers to pursue personal goals (Young, 1986), sources of competition for private, government, or other nonprofit firms (Rose-Ackerman, 1986), the cost advantage due to favorable tax treatment (Lakdawalla and Philipson, 2006), or a way to provide a more diverse set of services to the service sector (Rose-Ackerman, 1996). Steinberg (2006) points out that even though these theories provide valuable insights into understanding why nonprofit organizations exist, they do not predict the timing of nonprofit entry in the market place.

This void can be addressed by research in the second category—the behavior of nonprofit organizations. Specifically, Laincz (2008) examine the entry and exit decisions of nonprofit organizations. Other research related to the behavior of nonprofit organizations includes the choice of objective—service, revenue, or quality maximizers—by organization officials (Hansmann, 1981; Steinberg, 1986; Luksetich and Lange, 1995; Brooks and Ondrich, 2007), fundraising decisions (Rose-Ackerman, 1982, 1987), service and commodity provision decisions (Calmette and Kilkenny, 2001; Steinberg and Weisbrod, 2005), and strategic tax planning behavior (see Yetman and Yetman, 2008, for tax planning strategies using taxable
subsidiaries and see Omer and Yetman, 2007, for tax planning strategies using unrelated business activity).

Other research examines the demand for a nonprofit organization’s goods and services. In the market for charitable goods and services, those who supply donations are thought to demand the goods and services provided by nonprofit organizations. This area of research examines the way in which fundraising expenditures affect private donations a nonprofit receives (Weisbrod and Dominguez, 1986; Okten and Weisbrod, 2000), how operational efficiency affects the donations a nonprofit organization receives (Frumkin and Kim, 2001), how rating systems affect total donations (Gordon, Knock, and Neeley, 2009), and how locations of corporate headquarters affect donation receipts of local charities (Card, Hallock, and Moretti, 2010).

Research related to nonprofit organizations has covered many different avenues, yet there are still others to be explored. The objective of the current research is to study how the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) affected the behavior of a specific type of nonprofit organizations—philanthropic organizations. The tax cuts that occurred in 2003 were initially set to occur in 2006. These tax cuts were outlined in the Economic Growth and Tax Relief Reconciliation Act of 2001 (EGTRRA). This law initially designated tax rate changes that would occur over the next several years. Changes that took place in 2002 include a 10% bracket for lower income single, joint, and head of household filers and indexing the lower threshold of the 15% bracket to the new 10% bracket. Major changes scheduled to occur in 2006 were to lower the 28% bracket to 25%, lower the 31% bracket to 28%, lower the 36% bracket to 33%, and lower the 39.6% bracket to 35%. The capital gains taxes on qualified property or stock was lowered from 10% to 8% in EGTRRA.
The estate tax exclusion threshold gradually increased from $650,000 in 2001 to $3,500,000 in 2009. In 2010, there was to be no estate or generation-skipping tax.

A slow economic recovery spurred the passing of the Jobs and Growth Tax Relief Reconciliation Act (JGTRRA) of 2003. Key points of this act include the acceleration of the income tax cuts designed to occur in 2006 and an increased upper income limit in each bracket. Given these reforms, one would expect donations, that can be counted as an itemized deduction, to increase in the year before the cuts will take effect, and to decrease once the cuts take effect (though the tax rate cuts were not as drastic as those in the 1980’s). There is also the incentive of philanthropic organizations to adjust behavior in an effort to achieve its service goals and can maintain a degree solvency on a year-to-year basis.

In this study, I focus on philanthropic organizations because their objective is clear and relatively easy to measure. I think of philanthropic organizations as clearing houses for donations, whereas organizations such as hospitals, educational institutions, and museums have a product that they sell for revenue.\(^{38}\) My objective is to study how and why these organizations adjust their behavior when tax rates change.

---

\(^{38}\)Steinberg (1986) estimates a parameter that reveals whether a nonprofit organization’s objective is to maximize the amount of services it provides (total value of food given to the poor), or if the organization primarily focused on revenue generating activities. His model is simple and intuitive but assumes that non-contribution revenues, such as revenues received from the sale of goods and services, are exogenous. This assumption is too strong for hospitals and educational institutions that participate in markets in which they determine the quality and quantity of specific goods and services. This assumption, however, is valid for philanthropic organizations since these organizations generally focus on distributing donated dollars to particular causes and not on producing a marketable good or service. Steinberg (1986) finds that welfare organizations, that can correspond to philanthropic organizations to some degree, maximize expenditures on services (though the result is weak).
3.3 Model

In my model, I assume that a philanthropic organization maximizes the discounted sum of expenditures on services, e.g., total dollars spent on aid to the poor, where these expenditures are the residual expenses after subtracting all other expenses from the revenues generated by the organization. The mathematical function for service expenditures is

\[ y_t \equiv e_{t-1} (1 + r) + h_t + g_t + d(t) \left( f_t, m_t, g_t, \gamma(t), I_t, r, \tau_t \right) - f_t - m_t - a_t - e_t, \]  
(3.1)

and the present value of the discounted stream of service expenditures is

\[ V = \sum_{t=1}^{\infty} \beta^{t-1} \left( e_{t-1} (1 + r) + h_t + d(t) \left( f_t, f_{t-1}, m_t, \gamma(t), y_{t-1}, I_t, r, \tau_t \right) \right) - \beta^{t-1} (-f_t - m_t - a_t - e_t), \]  
(3.2)

where \( \beta \) is the discount factor and \( \beta = \frac{1}{1+r} < 1 \), \( e_{t-1} \) is the amount of savings from the previous period, \( r \) is the expected return in savings and investment, \( h_t \) is revenues other than donations and government grants (assumed to be exogenous), \( g_t \) is government grants, \( d(t) \left( \cdot \right) \) is the market donations function the philanthropic organization faces and does not vary over time (I put the time subscript in parentheses to keep track of the partial derivatives of \( d(t) \left( \cdot \right) \) with respect to its arguments and to remember the specific time period, but to make note that the donations function is not time variant), \( f_t \) is the amount spent on non-employee related fundraising, \( m_t \) is the amount of employee related fundraising expenses, \( \gamma(t) \) is the average proportion of each donated dollar that is used for service output—which we refer to as the effective donation rate (similar to the donations function, we assume that the effective donation rate is constant over time, but we place a time subscript in parentheses to keep track of partial derivatives and the appropriate time period), \( I_t \) is a measure of income.
(exogenous to the organization) that affects donations available in the market place, $\tau_t$ is the current tax structure for individuals (includes income and capital gains tax structures), $a_t$ is exogenous expenses the firm must pay (this includes other employee expenses and payments to affiliates), and $e_t$ is the amount the organization saves in period $t$.

I define the effective donation rate as

$$\gamma(t) \equiv \gamma \left( \frac{d(t-1)(\cdot) - f_{t-1} - m_{t-1}}{d(t-1)(\cdot)} \right)^{\nu}. \quad (3.3)$$

This rate directly relates to the “price” variable in the Weisbrod and Dominguez (1986) and Okten and Weisbrod (2000) papers. In these two articles, the “price” of donating is the amount required to generate one dollar of output. In their research, the authors assume that $\nu = -1$. I choose to allow $\nu = 1$ for a couple of reasons. First of all, I estimate the parameters of my model when $\nu = -1$ and when $\nu = 1$ and the log-likelihood value from the regression that corresponds to $\nu = 1$ is greater. Second, I use a quadratic approximation to estimate the effects of the variables in the market donations function so it makes sense to leave the effective donation rate in its standard form ($\nu = 1$) instead of imposing an additional from on this variable.

Although the information the effective donation rate provides does not change when $\nu = 1$ or $\nu = -1$, the interpretation does differ. If $\nu > 0$, then donors perceive this value as the amount of service output generated with each dollar donated. If $\nu < 0$, the donors perceive this value as the amount required to generate one dollar of output. While the difference in these interpretations may be only a matter of semantics, there is evidence for framing effects in public goods games (Andreoni, 1995). When a philanthropic organization understands how donors perceive the donation, then they can better understand how to
solicit donations. For example, if $\nu > 0$, it may be more effective for the organization to provide information about the amount of each donated dollar that passes through and becomes a service expenditure. If $\nu < 0$, then donors may only focus on how much is required to generate one dollar of service expenditures. Even though the information is the same, the perception of the information can affect donation decisions. In future research it would be interesting to estimate $\nu$ to determine the market perception regarding the effective donation rate.

It is important to note that I do not use a function that represents the marginal proportion of each dollar that is designated to service output because such information is not available. I use the average proportion from the previous period because the donor can observe this proportion. I also assume that the function is the same across periods, but the observations differ across periods.

To simplify the derivation of the first order conditions for the organization’s decision problem and comparative statics results, I use the general donations function $d(t) = \int d(t)(f_t, m_t, g_t, \gamma_t) (d(t-1), f_{t-1}, m_{t-1}), I_t, r, \tau_t)$ and I use the actual function form for the effective donations rate when I specify the functional form for the donations function.

The organization’s decision problem is to maximize equation (3.2) subject to the non-negativity constraints

$$f_t \geq 0, m_t \geq 0, \text{ and } e_t \geq 0.$$  \hspace{1cm} (3.4)

The first order condition for non-employee related fundraising expenditures simplifies to

$$\frac{\partial V}{\partial f_t} = 1 - \left[ \frac{\partial d(t)}{\partial f_t} + \beta \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial f_t} \right] \geq 0.$$  \hspace{1cm} (3.5)

Fundraising in the current period affects donations in the current period and donations in
the following period. Furthermore, fundraising in the current period affects donations in the following period indirectly through the effective donations rate—through $\frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial f_t}$. It makes sense for $\frac{\partial d(t)}{\partial f_t} > 0$. Since I assume that $\nu = 1$, it would also make sense for $\frac{\partial d(t+1)}{\partial \gamma(t+1)} > 0$ since one would expect donors to respond positively to a more effective use of each donated dollar. The sign of the last piece, $\frac{\gamma(t+1)}{\partial f_t}$, is unknown. Based on the functional form for the $\gamma$ function, the sign depends on the value of total fundraising expenses (both non-employee and employee), the magnitude of $\frac{\partial d(t)}{\partial f_t}$, and the total amount of donations.

A closer look at equation (3.5) shows that the overall effect of non-employee related fundraising expenses on donations is always equal to 1. For an interior solution, the model predicts that $1 = \frac{\partial d(t)}{\partial f_t} + \beta \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial f_t}$, i.e., the total effect of fundraising on donations equals 1. I must point out that the marginal effect of employee related fundraising expenses is also important in this effect, so I cannot ignore that effect.

The first-order condition for employee related fundraising expenses simplifies to

$$\beta^{-1} \geq 1 + r.$$  

This first order condition is virtually identical to the first order condition for non-employee related fundraising expenses. The discussion regarding the sign of the partial effects are similar as well.

The first order condition for the savings variable simplifies to to

$$\frac{\partial V}{\partial m_t} = 1 - \left[ \frac{\partial d(t)}{\partial m_t} + \beta \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial m_t} \right] \geq 0. \quad (3.6)$$

In order to simplify the first order conditions to equations (3.5) and (3.6), I assume that $\frac{\partial d(t)}{\partial \gamma(t)}$ and $\frac{\partial \gamma(t)}{\partial f_{t-1}}$ are constant over time. This requires that the variables grow at the same rate.
By assumption, however, this must hold with equality, so that $e_t > 0$, which is realistic.

I also derive the elasticity of the market donations function with respect to non-employee and employee related fundraising expenses. The elasticity of donations with respect to non-employee fundraising expenses is (assuming an interior solution)

$$
\varepsilon_{d(t), f_t} = \left[ 1 - \beta \frac{\partial d_{t+1}}{\partial \gamma_{t+1}} \frac{f_t}{d_t} \right],
$$

(3.8)

and the elasticity of donations with respect to employee related fundraising expenses is (assuming an interior solution)

$$
\varepsilon_{d(t), m_t} = \left[ 1 - \beta \frac{\partial d_{t+1}}{\partial \gamma_{t+1}} \frac{m_t}{d_t} \right].
$$

(3.9)

In both cases, by virtue of the first order conditions, and assuming that $f_t < d_{t(t)}$ and $m_t < d_{t(t)}$, the elasticities are less than 1.

### 3.3.1 Comparative Statics

The first-order conditions listed above provide the optimal decision rules for philanthropic organizations. To derive the comparative static results, I assume an interior solution and then totally differentiate $\frac{\partial V}{\partial f_t}$ and $\frac{\partial V}{\partial m_t}$ with respect to $f_t$, $m_t$, and $\tau_t$. I then use Cramer’s rule to derive $\frac{df_t}{d\tau_t}$. In order to use Cramer’s rule to derive the comparative static results, I first need to define the system of equations. This system is given by

$$
A \begin{bmatrix} df_t \\ dm_t \end{bmatrix} = d\tau_t B,
$$

(3.10)

where $A$ is the 2x2 coefficient matrix of partials and crosspartials of $m_t$ and $f_t$. This matrix is given by
\[
\begin{bmatrix}
A_{11} & A_{12} \\
A_{21} & A_{22}
\end{bmatrix} = \\
\left[
-\frac{\partial}{\partial f_t} \left[ \frac{\partial d(t)}{\partial f_t} + \beta \left( \frac{\partial d(t+1)}{\partial f_t} + \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial f_t} \right) \right] - \frac{\partial}{\partial m_t} \left[ \frac{\partial d(t)}{\partial m_t} + \beta \left( \frac{\partial d(t+1)}{\partial m_t} + \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial m_t} \right) \right] \\
-\frac{\partial}{\partial f_t} \left[ \frac{\partial d(t)}{\partial m_t} + \beta \left( \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial m_t} \right) \right] - \frac{\partial}{\partial m_t} \left[ \frac{\partial d(t)}{\partial m_t} + \beta \left( \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial m_t} \right) \right]
\right].
\]

(3.11)

The \( A_{11} \) element is the rate of change of equation 3.5 as \( f_t \) changes and the \( A_{12} \) element is the marginal effect of \( m_t \) on 3.5. \( A_{21} \) is the marginal effect of \( f_t \) on 3.6 and \( A_{22} \) is the rate of change 3.6 as \( m_t \) changes.

The \( B \) matrix is populated with the marginal effect of \( \tau_t \) on the first order conditions and is given by

\[
\begin{bmatrix}
B_{11} \\
B_{21}
\end{bmatrix} = \\
\left[
\frac{\partial}{\partial \tau_t} \left[ \frac{\partial d(t)}{\partial f_t} + \beta \left( \frac{\partial d(t+1)}{\partial f_t} + \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial f_t} \right) \right] \\
\frac{\partial}{\partial \tau_t} \left[ \frac{\partial d(t)}{\partial m_t} + \beta \left( \frac{\partial d(t+1)}{\partial \gamma(t+1)} \frac{\partial \gamma(t+1)}{\partial m_t} \right) \right]
\right].
\]

(3.12)

The \( B_{11} \) element expresses the marginal effect of \( \tau_t \) on 3.5 and the \( B_{21} \) element is the marginal effect of \( \tau_t \) on 3.6. By Cramer’s rule, the solution to 3.10 is

\[
\frac{\partial f_t}{\partial \tau_t} = \frac{B_{11}A_{22} - A_{12}B_{21}}{A_{11}A_{22} - A_{12}A_{21}}, \\
\frac{\partial m_t}{\partial \tau_t} = \frac{A_{11}B_{21} - B_{11}A_{21}}{A_{11}A_{22} - A_{12}A_{21}}.
\]

(3.13)

The signs of \( \frac{\partial f_t}{\partial \tau_t} \) and \( \frac{\partial m_t}{\partial \tau_t} \) rely on the unknown sign of the cross partial effect of non-employee and employee related expenses on the market donations function.

### 3.4 Functional Form

In order to estimate the relationship between the market donations function and its input variables, I need to select a functional form for the donations function. I use the
quadratic form since it is fairly flexible and still parsimonious, relative to other functional forms for structural production functions. It is also a second order approximation to the actual function. The functional form is

\[ d(t) = \alpha_0 + x_t'\alpha + x_t'Qx_t, \]  

(3.14)

where the vector \( x \) is a vector of explanatory variables and

\[ x'_t = \begin{bmatrix} x_{1t}, & x_{2t}, & x_{3t}, & x_{4t}, & x_{5t}, & x_{6t}, & x_{7t}, & x_{8t} \end{bmatrix} = \begin{bmatrix} f_t, & f_{t-1}, & m_t, & \gamma_t, & y_{t-1}, & I_t, & r, & \tau_t \end{bmatrix}. \]

Furthermore, \( \alpha \) is a vector of parameters to be estimated, and \( Q \) is a symmetric matrix of parameters to be estimated. The parameters in \( Q \) correspond to the products and cross-products of the variables in the \( x_t \) vector.

This functional form allows for zeros in the observations and does not restrict the sign or magnitude of the marginal effects of the explanatory variables on the dependent variable. It is homogeneous of degree one when there are no cross partial effects and when \( \alpha = 0 \), which is likely not the case in this situation. This is not a major concern since this function is not a standard production function with prices, but a function that explains the process of generating donations. Thus, it is not requisite to rely on a functional form that allows for specific properties of the inputs in the services production process, or in the optimal input functions.
3.5 Data

In this study, I use the publicly available information on the IRS Form 990 files that are published by the IRS. Each year, the IRS collects a sample of organizations that file under IRS Code 501c(3-9) and reports a substantial amount of the information in the organization’s 990 file. The sampling rate of the largest organizations (assets greater than $50,000,000) is 100%, and the sampling rate decreases with lower asset tiers. This allows for a panel study, over a long time period, of the largest organizations. The available information includes private donations received, government grants, other revenues from unrelated business activities or taxed subsidiaries, fundraising expenditures, employee expenditures, expenditures on services, financial information, the NTEE class, state, and zip code.

The available data covers the years 1992 to 2007, a sixteen year period. The data contain observations for 4,457 organizations over the entire time series—a total of 71,312 observations. Since I exclusively study philanthropic organizations, the sample is restricted to 218 organizations over the sixteen year period for a total of 3,488 organizations. Of these 218 organizations, 15 report zero fundraising for all 16 years and 1 reports zero non-employee related fundraising expenses for 15 of the years. Since I focus on behavior that affects the market donation function, I consider the organizations that report no non-employee fundraising expenses for the entire 16 year period as outside the scope of the model. Therefore, I drop these organizations from the data set. After dropping these 16 organizations, and two other organizations that have headquarters outside the US, the remaining sample consists of 200 organizations observed for a period of 16 years for a total of 3,200 observations. Of
these remaining organizations, 226 report zero donations (28 organizations report zero donations at least once) and only 4 report zero donations 15 years (no organization reports zero donations for all 16 years). The theoretical and structural models both allow for zeros in fundraising and employee expenses so they are not of any concern. Since none of the organizations report zero donations for all 16 years, and since 96% of the organizations that report zero donations also report zero fundraising expenses, I consider them of no concern. Since the data are censored at 0 I use the Tobit estimation procedure to account for the censored nature of the data.

Table 3.0 lists several of the variables available in the IRS 990 files. Each variable corresponds to a variable in equation (3.1), except for total resources which is the sum of all revenues available to the organization, and its observations are drawn from the IRS 990 files. For the revenue variables, \( e_{t-1} \) variable is measured as the previous period’s savings, \( e_{t-1}r \) corresponds to savings and investment returns, \( h_t \) is measured as program service revenues and government grants, and the market donations function, \( d(t)(\cdot) \) is measured as donations received by the organization. For the expense variables, the \( y_t \) variable is measured as program service expenses (the desired output of the philanthropic organization), \( f_t \) is measured as fundraising expenses, \( m_t \) is measured as employee expenses targeted directly at generating donations and program service expenses, \( n_t \) is measured as employee and other expenses not directly related to generating donations and service expenses, and \( e_t \) is measured as savings in the current period.

The market donations function includes \( \gamma(t) \) which which is calculated based on the formula in equation 3.3, \( I_t \) which is measured as state or national total personal income, \( r \) which is measured as the annual S&P 500 Index, and \( \tau \) which is a dummy variable that
takes on a value of zero for 1992-2002 and a value of 1 for 2003-2007. I use total personal income as the income measure because donations are measured as total donations received by the philanthropic organization. Thus, it makes sense to use a measure of total income the philanthropic organization can draw on to fund its activities. Since some philanthropic organizations engage in services relevant only to the local community and others engage in services that are more national in scope, I use state total personal income for the locally oriented organizations and US total personal income for the nationally oriented organizations.

The effective donations rate is a measure of the ratio of residual donations after accounting for employee and fundraising expenses to total donations. In the sample, 164 organizations reported donations that were less than the sum of fundraising and employee expenses. A donor would perceive this situation as zero efficiency for each donated dollar, so I set these values equal to zero.

Table 3.1 reports the mean values (in millions of $US) of the variables of interest prior to the tax law, and after the tax law passed. These variables are divided into revenue and expense variables. It is not surprising that the averages of each variable differ before and after 2003. Data for the revenue variables show that mean savings increased by roughly 67%, the mean return on savings increased by more than 100%, mean total private donations increased by about 31%, mean exogenous revenues increased by about 0.5%, and mean total resources increased by roughly 51%. Data for the expenditure variables show that the mean amount spent on services increased by about 36%, mean non-employee related fundraising expenditures decreased by about 2.2%, mean employee related fundraising expenses increased by about 21%, mean exogenous expenditures increased by about 15%, and mean savings in the current period increased by about 55%.
This review of the data reveals an adjustment before and after the tax law passed. While donations the organizations received increased, non-employee related fundraising expenditures decreased and employee related fundraising expenditures increased. In the following section, I use marginal effects and elasticities to shed more light on the behavioral adjustment of philanthropic organizations.

### 3.6 Empirical Method and Results

The structural equation for the empirical analysis is given by equation (3.14), including an error term. Since some organizations report zero donations, I will use a Tobit random effects model, thus, I will need to include a second source of error in the primary equation. The equation I will estimate is

\[ d_{i(t)} = \alpha_0 + x'_{it}\alpha + x'_{it}Qx_{it} + u_i + \omega_{it}, \tag{3.15} \]

where \( u_i \sim N(0, \sigma_u^2) \) is the unknown organization specific error term with a mean of zero and an equal variance across organizations. The second error term, \( \omega_{it} \sim N(0, \sigma_\omega^2) \) is the random error term for each organization \( i \) at each time period \( t \) and has a mean of zero and a variance that is equal across time and organizations.

From the parameter estimates of the model, i.e., estimates of the vector \( \alpha \) and the matrix \( Q \), I estimate the marginal effects for each variable and test the difference in the marginal effects before and after JGTRRA passed. I also estimate the elasticity for each variable before and after JGTRRA passed. Finally, I test whether there is a difference in predicted donations to determine if the behavioral changes by the philanthropic organization contribute to the increase in donations after JGTRRA passed.
The parameter estimates are presented in Tables 3.2, 3.3, and 3.4. Since the functional form is quadratic in the variables, and since the data are left censored at zero, the parameter estimates are neither marginal effects nor are they the correct quadratic or cross-partial effects. Therefore, I construct the marginal effects of each variable and report them in Table 3.5.

The marginal effects reveal interesting behavior before and after the tax law passed. In the years preceding JGTRRA (1992-2002), an additional dollar spent on fundraising generated an additional $9.12 in donations. This suggests a high return, in terms of donations, on each dollar spent on non-employee fundraising expenses. After JGTRRA (2003-2007), the effect of fundraising is $3.52, and the difference between this marginal effect and the marginal effect previous to JGTRRA is statistically significant. Thus, it is clear that each marginal dollar spent on non-employee fundraising lost its effectiveness, and this result can explain why non-employee fundraising expenses decreased after JGTRRA.

The marginal effect of employee expenses related to fundraising prior to JGTRRA is $9.58, so once again, there appears to be a high return, in terms of donations, to employee-related fundraising expenses. These expenses also enter the effective donation rate and the total effect that these expenses have on donations is $6.65 and is statistically different than zero. After JGTRRA, the marginal effect of fundraising is $11.02, so it appears that employee-related fundraising expenses increased in effectiveness. Since donations became more expensive for those in the top income brackets, then philanthropic organizations may have taken steps to improve the donation generating capacity of each employee that dedicated time to fundraising. This could explain the increase in employee-related expenditures after JGTRRA passed.
The marginal effects of non-employee and employee fundraising suggest a high return to fundraising expenditures, both before and after JGTRRA. According to the first order conditions, the effect of non-employee and employee related fundraising expenditures on donations should equal 1. In other words, an organization would fundraise until the total return on each dollar spent is equal to one. The results in this paper suggest that the organization is not behaving in this manner. There are several possible explanations for this result. First of all, both non-employee and employee related fundraising enters the effective donation rate as a lagged variable, thus the influence of fundraising passes from one period to the next. The effect of both fundraising expenses in this variable, however, have a negative impact on donations. Thus, when this effect is included, one would expect the marginal effect to decrease. Another explanation could be that there are effects from fundraising that cannot be accounted for in simple non-employee and employee related fundraising expenditures. For example, a fundraising message may spread rapidly via word of mouth so the total effect of the expenses is magnified through social networks. Also, fundraising expenditures may be picking up behavior that is not accounted for in the model. For example, if a natural disaster occurs in a particular region, donors may be willing to contribute more, regardless of fundraising efforts. Thus, fundraising may appear to be more effective than it actually is. It could be difficult for organizations to guess how a message will spread in social networks and natural disasters are impossible to predict, so organizations are not able to take advantage of the higher returns to fundraising expenditures.

A common question in the donations literature is the effect that government expenditures has on donations. I found that the marginal effect of government grants to philanthropic organizations has a negative effect equal to -$1.35 and -$1.10, before and after
JGTRRA, respectively. The difference in these results is not statistically significant, and only the marginal effect of government grants before JGTRRA is statistically significant. Furthermore, a separate test reveals that neither of these variables are statistically different than 1. This suggests that prior to JGTRRA, government government grants, perfectly crowded-out private donations to philanthropic organization (dollar-per-dollar). It is interesting, however, that after JGTRRA, mean government grants increased. Furthermore, the ratio of average government grants to average donations increased from 0.0129 to 0.0140, so there was a slight increase in the fraction of government grants relative to donations. Even with this increase in government grants, donors responded less to government grants after JGTRRA. Donors may have understood how the increase in the price of giving likely increased the difficulty of acquiring donations, so donors did not respond as negatively to government grants after JGTRRA.

The next variable of interest is the effective donations rate, or the measure of how efficiently each donated dollar is used. I find that prior to JGTRRA, an 1 unit increase in the effective donations rate results in a $37.09 increase in donations. After JGTRRA, a one unit increase in the effective donations rate results in a $43.84 increase in donations. These results are both statistically significant and their difference is statistically significant. Thus, donors appear to reward organizations more, in terms of donations, after JGTRRA for efficient use of each donated dollar.

The marginal effect of income before JGTRRA suggests that for each dollar increase in total personal income in a particular region, donations will increase by $0.007 and after JGTRRA, the marginal effect increases to $0.009. These effects are small, but it is important to remember that these effects also capture regions specific factors, and may not be a
good representation of the population of donors, since the income measure includes incomes from all residents of a particular region. The difference in these two values is statistically significant.

The S&P index is meant to capture the effect that savings and investment returns have on donations. Since I do not have individual specific information on returns, the variable is a yearly variable and does not vary from organization to organization. Therefore, this variable also picks up other yearly effects. Nonetheless, the marginal effect of a one point increase of the S&P Index results in $0.002 in additional donations, prior to JGTRRA. After JGTRRA, a one point increase in the S&P Index results in $0.004 in additional donations. Thus, as the S&P Index increases, donations increase, and this effect is greater, in a statistical sense, after JGTRRA.

I also calculated the elasticities for each variable before and after JGTRRA. The elasticity of non-employee fundraising expenditures decreased from 0.21 before JGTRRA to 0.081 after JGTRRA. Before JGTRRA, a 1% increase in non-employee fundraising resulted in a 0.21% increase in donations, and after JGTRRA this response decreased to a 0.081% increase in donations. Thus, donors became less responsive to percentage increases in non-employee fundraising expenditures.

The decrease in the elasticity of non-employee fundraising expenditures after JGTRRA is in contrast to the increase in employee related fundraising expenditures after JGTRRA. To be specific, the elasticity of employee related fundraising expenditures increased from 0.56 before JGTRRA to 0.64 after JGTRRA. Therefore, donors initially contributed an additional 0.56% for each additional 1% increase in employee related fundraising expenditures and this response changed to an increase of 0.64% after JGTRRA.
The elasticity of government grants prior to JGTRRA is -0.017 so a 1% increase in government grants leads to a 0.017% decrease in donations. After JGTRRA, the elasticity of government grants is -0.014, but this value is not statistically significant. Once again, this decrease in responsiveness to government grants may be a result of donor understanding regarding the potential difficulty in acquiring donations, so they are much less responsive—in a negative way—to government grants.

The elasticities of the effective donation rate before and after JGTRRA provide a clearer picture, compared to the marginal effect, regarding donor responsiveness to this variable. Prior to JGTRRA, I find that a 1% increase in the effective donation rate results in a 2.19% increase in donations. This shows that donors are very responsive to the way in which philanthropic organizations use each donated dollar. After JGTRRA passed, I find that a 1% increase in the effective donation rate results in a 2.59% increase in donations. This increase suggests that after JGTRRA, donors likely became more cautious regarding the effective use of each donated dollar. Thus, while they responded more positively to an increase in the efficient use of each donated dollar, they also responded more negatively to a decrease in this efficiency.

The elasticity of income prior to JGTRRA is 0.326 and after JGTRRA is 0.418. Thus, the response of donors became more elastic as disposable incomes likely increased as a result of the law. Also, the elasticity of the S&P index prior to JGTRRA is 0.164 and after JGTRRA is 0.308. Once again, as investment opportunities improve, donors are more willing to give, and this responsiveness increases after JGTRRA.

Finally, the value of predicted donations prior to JGTRRA does not differ in a statistical sense from predicted donations after JGTRRA. This result is similar to that of Auten et
First of all, this result suggests that while the behavioral changes of philanthropic organizations do not account for the increase in donations after JGTRRA, the adjustments are a significant factor in maintaining a consistent level of donations after the price of giving increased. Second, this result also suggests that there are other factors outside of this model that affect giving. This effect could be the warm glow effect as coined by Andreoni (1990), a prestige effect as discussed by Harbaugh (1998), or other effects that have yet to be discovered.

In summary, the results reveal that donors respond less to non-employee related fundraising expenditures after JGTRRA. This is in contrast to the increase in donor responsiveness to increases in employee-related fundraising expenses. This could be a result of increased effectiveness of employees, in terms of generating additional donations. Also, it appears that government grants did not crowd out investments as much after JGTRRA and this helps explain the increase average government grants received by philanthropic organizations. After JGTRRA, the effective donation rate has a greater impact on donations, and this is likely due to the fact that donors are more cautious regarding the effective use of each donated dollar. I also find positive effects from income and a measure of investment opportunities, and the effect of income increases after JGTRRA. Finally, this behavioral adjustment ensures a constant level of donations before and after JGTRRA, but is not able to capture the increase in donations observed.
3.7 Conclusion

While the literature for the effects of tax policy on individual donors is well developed, there is not as much research that addresses the effects of tax policy on the behavior of philanthropic organizations. In order to fill this gap, I develop a model that incorporates the long-term decision horizon of philanthropic organizations. In this model, their primary objective is to maximize the discounted stream of program service expenditures. To generate revenues, philanthropic organizations use non-employee and employee related fundraising expenditures to raise revenue through donations. These organizations also use an efficiency measure to attract donations. Since changes in tax policies directly affect donations, the effects are spread to philanthropic organizations as they determine how to respond.

I find that the change in tax rates in 2003 had a significant impact on donations received by philanthropic organizations. My data also suggests that this change in tax rates led to a change in their behavior. It is important to understand how philanthropic organizations respond to these policies since they are a key source of funding for charitable services. I find that the tax law results in a decrease in the effectiveness of non-employee related fundraising expenses, but an increase in the effectiveness of employee related fundraising expenses. This can explain why non-employee related fundraising expenses fell and employee related expenses increased after JGTRRA. I also find that the elasticities of non-employee and employee related fundraising expenses are less than 1 both before and after JGTRRA and this is consistent with my theoretical model. Finally, I find that predicted donations do not change before and after JGTRRA so while changes in philanthropic organizations’ behavior ensures a consistent level of donations, these changes do not account for the increased level
of giving observed in the data.

There are various avenues for future research. First of all, it would be interesting to combine both sides of the market, i.e., donors and philanthropic organizations, and study the effects of various inputs on the simultaneous equations of demand and supply of donations. It would also be interesting to study how and why the behavior of nonprofit organizations differ, if at all, after the 1986 tax reform and the 2003 tax cut. Finally, it would be interesting to study how this tax law affects other nonprofit organizations. This would require the development of appropriate objective functions for other nonprofit organizations, but understanding these effects can help these organizations best meet their goals.
<table>
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<td>Total Resources</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
</tr>
<tr>
<td>Service Expenditures</td>
</tr>
<tr>
<td>Non-Employee Fundraising</td>
</tr>
<tr>
<td>Employee Fundraising</td>
</tr>
<tr>
<td>Exogenous Expenses</td>
</tr>
<tr>
<td>Savings (t)</td>
</tr>
</tbody>
</table>
Table 3.3: Parameter Estimates in the Market Donations Function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>P-value</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>18.200</td>
<td>5.858</td>
<td>0.002</td>
<td>6.700</td>
<td>29.662</td>
</tr>
<tr>
<td>Fundraising (F)</td>
<td>11.518</td>
<td>8.117</td>
<td>0.156</td>
<td>-4.391</td>
<td>27.428</td>
</tr>
<tr>
<td>Employee Expenses (Emp)</td>
<td>-1.329</td>
<td>1.457</td>
<td>0.362</td>
<td>-4.185</td>
<td>1.527</td>
</tr>
<tr>
<td>Government Grants (G)</td>
<td>-5.981</td>
<td>3.246</td>
<td>0.065</td>
<td>-12.344</td>
<td>0.381</td>
</tr>
<tr>
<td>Effective Donation Rate (EDR)</td>
<td>-79.808</td>
<td>10.549</td>
<td>0.000</td>
<td>-100.484</td>
<td>-59.133</td>
</tr>
<tr>
<td>Total Personal Income (I)</td>
<td>-0.003</td>
<td>0.005</td>
<td>0.518</td>
<td>-0.012</td>
<td>0.006</td>
</tr>
<tr>
<td>S&amp;P 500 Index (R)</td>
<td>-0.011</td>
<td>0.008</td>
<td>0.172</td>
<td>-0.026</td>
<td>0.005</td>
</tr>
<tr>
<td>Tax Structure (T)</td>
<td>-10.215</td>
<td>7.018</td>
<td>0.146</td>
<td>-23.969</td>
<td>3.540</td>
</tr>
<tr>
<td>F*F</td>
<td>2.008</td>
<td>0.259</td>
<td>0.000</td>
<td>1.500</td>
<td>2.516</td>
</tr>
<tr>
<td>F*Emp</td>
<td>-3.423</td>
<td>0.430</td>
<td>0.000</td>
<td>-4.265</td>
<td>-2.581</td>
</tr>
<tr>
<td>F*G</td>
<td>0.795</td>
<td>0.370</td>
<td>0.031</td>
<td>0.071</td>
<td>1.520</td>
</tr>
<tr>
<td>F*EDR</td>
<td>16.524</td>
<td>8.486</td>
<td>0.052</td>
<td>-0.109</td>
<td>33.158</td>
</tr>
<tr>
<td>F*I</td>
<td>0.001</td>
<td>0.001</td>
<td>0.141</td>
<td>0.000</td>
<td>0.003</td>
</tr>
<tr>
<td>F*R</td>
<td>-0.012</td>
<td>0.002</td>
<td>0.000</td>
<td>-0.015</td>
<td>-0.009</td>
</tr>
<tr>
<td>F*T</td>
<td>-7.523</td>
<td>1.336</td>
<td>0.000</td>
<td>-10.142</td>
<td>-4.904</td>
</tr>
</tbody>
</table>

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Table 3.4: Parameter Estimates in the Market Donations Function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>P-value</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMP*EMP</td>
<td>-0.084</td>
<td>0.074</td>
<td>0.256</td>
<td>-0.228</td>
<td>0.061</td>
</tr>
<tr>
<td>Emp*G</td>
<td>0.533</td>
<td>0.303</td>
<td>0.079</td>
<td>-0.061</td>
<td>1.127</td>
</tr>
<tr>
<td>Emp*EDR</td>
<td>13.905</td>
<td>1.512</td>
<td>0.000</td>
<td>10.942</td>
<td>16.869</td>
</tr>
<tr>
<td>Emp*I</td>
<td>0.005</td>
<td>0.000</td>
<td>0.000</td>
<td>0.005</td>
<td>0.006</td>
</tr>
<tr>
<td>Emp*R</td>
<td>0.000</td>
<td>0.001</td>
<td>0.504</td>
<td>-0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Emp*T</td>
<td>1.933</td>
<td>0.555</td>
<td>0.000</td>
<td>0.845</td>
<td>3.022</td>
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<tr>
<td>G*G</td>
<td>-0.460</td>
<td>0.134</td>
<td>0.001</td>
<td>-0.724</td>
<td>-0.197</td>
</tr>
<tr>
<td>G*EDR</td>
<td>2.228</td>
<td>3.137</td>
<td>0.477</td>
<td>-3.920</td>
<td>8.377</td>
</tr>
<tr>
<td>G*I</td>
<td>-0.001</td>
<td>0.001</td>
<td>0.056</td>
<td>-0.003</td>
<td>0.000</td>
</tr>
<tr>
<td>G*R</td>
<td>0.003</td>
<td>0.001</td>
<td>0.019</td>
<td>0.000</td>
<td>0.005</td>
</tr>
<tr>
<td>G*T</td>
<td>0.332</td>
<td>0.879</td>
<td>0.705</td>
<td>-1.390</td>
<td>2.054</td>
</tr>
<tr>
<td>EDR*EDR</td>
<td>58.818</td>
<td>9.112</td>
<td>0.000</td>
<td>40.959</td>
<td>76.677</td>
</tr>
<tr>
<td>EDR*I</td>
<td>0.004</td>
<td>0.001</td>
<td>0.000</td>
<td>0.002</td>
<td>0.006</td>
</tr>
<tr>
<td>EDR*R</td>
<td>0.015</td>
<td>0.004</td>
<td>0.000</td>
<td>0.007</td>
<td>0.024</td>
</tr>
<tr>
<td>EDR*T</td>
<td>9.056</td>
<td>3.078</td>
<td>0.003</td>
<td>3.023</td>
<td>15.089</td>
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</table>
Table 3.5: Parameter Estimates in the Market Donations Function

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>P-value</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>I<em>I I</em>I</td>
<td>0.000</td>
<td>0.000</td>
<td>0.003</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>I<em>R I</em>R</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>I<em>T I</em>T</td>
<td>0.003</td>
<td>0.001</td>
<td>0.001</td>
<td>0.001</td>
<td>0.004</td>
</tr>
<tr>
<td>R<em>R R</em>R</td>
<td>0.000</td>
<td>0.000</td>
<td>0.860</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>R<em>T R</em>T</td>
<td>0.003</td>
<td>0.005</td>
<td>0.589</td>
<td>-0.007</td>
<td>0.013</td>
</tr>
</tbody>
</table>

\[ \sigma_u = 36.282, \quad \text{Std. Err.} = 2.262, \quad \text{P-value} = 0.000, \quad \text{LCI} = 31.849, \quad \text{UCI} = 40.715 \]

\[ \sigma_\omega = 14.521, \quad \text{Std. Err.} = 0.213, \quad \text{P-value} = 0.000, \quad \text{LCI} = 14.102, \quad \text{UCI} = 14.939 \]

\[ \rho^* = 0.862, \quad \text{Std. Err.} = 0.016, \quad \text{P-value} = 0.829, \quad \text{UCI} = 0.890 \]

*\( \rho^* \) is the fraction of variation captured by the organization specific error. The formula is \( \rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_\omega^2} \)
### Table 3.6: Marginal Effects of Variables in the Market Donations Function

<table>
<thead>
<tr>
<th>Pre JGTRRA</th>
<th>Marginal Effect</th>
<th>Std. Err.</th>
<th>P-value</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundraising</td>
<td>9.123</td>
<td>1.523</td>
<td>0.000</td>
<td>6.138</td>
<td>12.109</td>
</tr>
<tr>
<td>Employee Expenses</td>
<td>9.577</td>
<td>0.662</td>
<td>0.000</td>
<td>8.280</td>
<td>10.874</td>
</tr>
<tr>
<td>Government Grants</td>
<td>-1.346</td>
<td>0.766</td>
<td>0.079</td>
<td>-2.846</td>
<td>0.155</td>
</tr>
<tr>
<td>EDR</td>
<td>37.090</td>
<td>4.284</td>
<td>0.000</td>
<td>28.693</td>
<td>45.486</td>
</tr>
<tr>
<td>Income</td>
<td>0.007</td>
<td>0.003</td>
<td>0.027</td>
<td>0.001</td>
<td>0.013</td>
</tr>
<tr>
<td>S&amp;P</td>
<td>0.002</td>
<td>0.001</td>
<td>0.007</td>
<td>0.001</td>
<td>0.004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post JGTRRA</th>
<th>Marginal Effect</th>
<th>Std. Err.</th>
<th>P-value</th>
<th>LCI</th>
<th>UCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundraising</td>
<td>3.517</td>
<td>1.694</td>
<td>0.038</td>
<td>0.197</td>
<td>6.837</td>
</tr>
<tr>
<td>Employee Expenses</td>
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<td>0.749</td>
<td>0.000</td>
<td>9.550</td>
<td>12.485</td>
</tr>
<tr>
<td>Government Grants</td>
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<td>1.002</td>
<td>0.273</td>
<td>-3.062</td>
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<tr>
<td>EDR</td>
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<td>0.003</td>
<td>0.010</td>
<td>0.002</td>
<td>0.016</td>
</tr>
<tr>
<td>S&amp;P</td>
<td>0.004</td>
<td>0.004</td>
<td>0.220</td>
<td>-0.003</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>F-stat</td>
<td>P-value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>--------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fundraising</td>
<td>31.690</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employee Expenses</td>
<td>12.120</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Grants</td>
<td>0.140</td>
<td>0.705</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDR</td>
<td>8.660</td>
<td>0.003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>11.810</td>
<td>0.001</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>S&amp;P</td>
<td>0.290</td>
<td>0.589</td>
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<tr>
<td></td>
<td>Pre JGTRRA</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Elasticity</td>
<td>Std. Err.</td>
<td>P-value</td>
<td>LCI</td>
<td>UCI</td>
</tr>
<tr>
<td>Fundraising</td>
<td>0.209</td>
<td>0.035</td>
<td>0.000</td>
<td>0.141</td>
<td>0.278</td>
</tr>
<tr>
<td>Employee Expenses</td>
<td>0.555</td>
<td>0.038</td>
<td>0.000</td>
<td>0.480</td>
<td>0.630</td>
</tr>
<tr>
<td>Government Grants</td>
<td>-0.017</td>
<td>0.009</td>
<td>0.079</td>
<td>-0.035</td>
<td>0.002</td>
</tr>
<tr>
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<td>2.194</td>
<td>0.253</td>
<td>0.000</td>
<td>1.697</td>
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<tr>
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<td>0.148</td>
<td>0.027</td>
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<td>0.615</td>
</tr>
<tr>
<td>S&amp;P</td>
<td>0.164</td>
<td>0.061</td>
<td>0.007</td>
<td>0.044</td>
<td>0.284</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Post JGTRRA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elasticity</td>
<td>Std. Err.</td>
<td>P-value</td>
<td>LCI</td>
<td>UCI</td>
</tr>
<tr>
<td>Fundraising</td>
<td>0.081</td>
<td>0.039</td>
<td>0.038</td>
<td>0.005</td>
<td>0.157</td>
</tr>
<tr>
<td>Employee Expenses</td>
<td>0.638</td>
<td>0.043</td>
<td>0.000</td>
<td>0.553</td>
<td>0.723</td>
</tr>
<tr>
<td>Government Grants</td>
<td>-0.014</td>
<td>0.012</td>
<td>0.273</td>
<td>-0.038</td>
<td>0.011</td>
</tr>
<tr>
<td>EDR</td>
<td>2.593</td>
<td>0.267</td>
<td>0.000</td>
<td>2.069</td>
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</tr>
<tr>
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<td>0.163</td>
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<td>0.736</td>
</tr>
<tr>
<td>S&amp;P</td>
<td>0.308</td>
<td>0.251</td>
<td>0.220</td>
<td>-0.185</td>
<td>0.800</td>
</tr>
</tbody>
</table>


Proposition 4 is a simplified result of the more general Proposition 5. I was able to simplify equation (4.1) of Proposition 5 by imposing the conditions $\frac{cy}{2a} - k < -\frac{cx}{2a}$, and $0 < \frac{m}{2cy} + \frac{cy}{4a} - k$. The steps are below.

In reference to equation (4.1), the assumption that $\frac{cy}{2a} - k < -\frac{cx}{2a}$ eliminates $\frac{cy}{2a} - k$ as a possibility for an optimal choice for $\delta_x$. The two conditions also make it so that $\Pi_x^v$ is not a feasible strategy so this eliminates the potential Nash Equilibrium strategy of $\Pi_x^v$. Finally, when the two conditions hold, $\Pi_x^i \left( -\frac{cx}{2a} \right) > \Pi_y \left( \frac{cy}{2a} \right) > 0$, from the analysis of the three-stage game. Therefore, equation (4.1) simplifies to equation (1.8) in Proposition 4.

Now, the proof for the more general result of Proposition 5 is below.

**Proposition 5.** If $2ma \geq c_y^2$, $\frac{cy}{2a} - k \leq 0 \leq \frac{m}{2cy} + \frac{cy}{4a} - k$ and

$$\Pi_x^i \left( \frac{m}{2cy} + \frac{cy}{4a} - k \right) > \max \left\{ \Pi_x^i \left( \max \left\{ \frac{-cx}{2a}, \frac{cy}{2a} - k \right\} \right), \Pi_x^v \left( \frac{cy}{2a} - k \right), 0 \right\},$$

(4.1)

then the low-cost firm drives the high-cost firm out of the market by increasing the consumer’s threshold level by advertisements ($\delta_x = \frac{m}{2cy} + \frac{cy}{4a} - k$) and setting a price $c_y$.

**Proof.** Since firm $x$ can make profits by (1.8), maximizing $\Pi_x(\delta_x)$ gives me the required fist-stage action of firm $x$. Then by $2ma \geq c_y^2$ I have to maximize $\Pi_x$ above intervals $[-k, \frac{cy}{2a} - k]$,
\[
\left[ \frac{ca}{2a} - k, \frac{m}{2c_y} - k + \frac{ca}{4a} \right], \left[ \frac{m}{2c_y} - k + \frac{ca}{4a}, \infty \right].
\]

From \( \frac{ca}{2a} - k \leq 0 \leq \frac{m}{2c_y} + \frac{ca}{4a} - k \) it follows that \( \Pi^i_x \) achieves its maximum at \( \frac{ca}{2a} - k \) within \( [-k, \frac{ca}{2a} - k] \), \( \Pi^i_x \) at \( \max \{ -\frac{ca}{2a}, \frac{ca}{2a} - k \} \) within \( \left[ \frac{ca}{2a} - k, \frac{m}{2c_y} - k + \frac{ca}{4a} \right] \) and \( \Pi^i_x \) at \( \frac{m}{2c_y} + \frac{ca}{4a} - k \) within \( \left[ \frac{m}{2c_y} - k + \frac{ca}{4a}, \infty \right] \); which completes the proof by considering \( \Pi_x (\delta_x), \delta_x^* (\delta_x) \) and \( \Pi_y (\delta_y) \).

\[\square\]

4.1.2 Content Descriptions

Direct Product Information

Price

This category is triggered if the price is either stated or conspicuously visible. It is not triggered, however, if the price is not stated and only visible in small print (inconspicuous).

Features

By definition, a feature is simply a product characteristic. It can be stated, shown, or written on the screen. A product feature is something easily observed or demonstrated visually or through verbal description. It can be stated by a narrator or character, shown, or provided in writing. For food, product features may include ingredients. This category is also triggered by close-up views of the product and explanations of new features added to existing products.

\[\text{40} \Pi^v_x (\delta_x) \] is negative in region (v).
Verifiable quality claims

A quality claim refers to product durability, how quickly it begins to work (consider household products), how long it will last, how much one can save in monetary terms by using the product, or any other attribute of the product’s quality. It is a verifiable claim if it can be directly verified by the consumer or by a third party (not the producer). It is possible that the claim is unstated but implied through imagery or sequences of images.

4.1.3 Situational Associations - Thresholds

Health

The health threshold refers to a situation where the product induces a positive change in the subjective well-being of a character. This category is triggered when at least seeing or hearing about the product induces a change in facial expression, a change in physical activity, or a marked change in health.

Survival

Advertisements may imply that those who don’t use the product suffer a negative effect. This category is triggered when a character (or implied character) who doesn’t use the product suffers death (or an implied death).

Courtship

The strong form of romance includes situations where a male (female) is wooing a female (male) (could already be a couple), there is a display of affection (hugging, kissing, touching), hearts are shown, flirting is evident, etc. A positive response would be triggered if
any of the above situations occur in a positive setting. A negative response would be triggered if it is apparent that either the male or female has at least romantic interest towards the other but the other behaves in a negative manner towards the one that has this romantic interest. For example, a man may give a woman an item of jewelry (advertised product) and she hugs him in return. This would trigger a positive response. On the other hand, a man may give a woman an item of jewelry (competitor’s product) and she rejects the gift and walks away. This would trigger a negative response. In either case, the strong form suggests that the average viewer could discern that the male and/or female had romantic interest towards each other. In advertisements during children’s programming, any explicit form of romance, i.e., hearts, display of affection, will trigger this category.

4.2 Appendix 2

4.2.1 Comparative Static Results

The comparative static results all have the same denominator which is given by

\[ p^2 u_{x1x1} v_{y1y1} (u_{x2Ns} + p^2 v_{y2Ny2N}) (u_{x2Ss} + \tilde{p}^2 v_{y2Sy2S}) - \\
(u_{x1x1} + p^2 v_{y1y1}) (-p^2 u_{x2Ns} u_{x2Ss} v_{y2Ny2N} \phi - \tilde{p}^2 v_{y2Sy2S} (1 - \phi) u_{x2Ss} (p^2 v_{y2Ny2N} + u_{x2Ns})) + \\
(u_{x1x1} + p^2 v_{y1y1}) (-p^2 u_{x2Ns} u_{x2Ss} v_{y2Ny2N} \phi - \tilde{p}^2 v_{y2Sy2S} (p^2 u_{x2Ns} v_{y2Ny2N} \phi)). \]

(4.2)

By assumption, \( u \) and \( v \) are decreasing in marginal utility so the denominator in the comparative static results is positive. It is important to note that \( u_{x2Ns} = u_{x2Nx2N} = u_{ss} \) and that \( u_{x2Ss} = u_{x2Sx2S} = u_{ss} \). This is because \( s \) and \( x_{2N} \) or \( x_{2S} \) enter utility as the sum of the storage and consumption of \( x \) in the respective state in period 2. Thus \( s \) enters utility as an additive
amount to either $x_{2N}$ or $x_{2S}$ so the marginal effect of $s$ on $u$ is the same as the marginal effect of $x_{2N}$ on $u$ or $x_{2S}$ on $u$, and thus $u_{x_{2N}s} = u_{x_{2N}x_{2N}} = u_{ss}$ and $u_{x_{2S}s} = u_{x_{2S}x_{2S}} = u_{ss}$.

I will now derive the comparative static results for $\frac{\partial s^*}{\partial \phi}$. The numerator of $\frac{\partial s^*}{\partial \phi}$ is

$$- \left( u_{x_1x_1} + p^2 v_{y_1y_1} \right) \left( u_{x_{2N}s} + p^2 v_{y_2Ny_2N} \right) \left( u_{x_{2N}} - u_{y_{2S}} \right) \left( u_{x_{2S}s} + \tilde{p}^2 v_{y_2Sy_2S} \right). \quad (4.3)$$

Since $u$ and $v$ are decreasing in marginal utility, then the first, second, and fourth terms in parentheses of $(4.3)$ are all negative. The third term in parentheses is also negative since the price is greater in the state when the consumer chooses $\tilde{p}$. Thus, $x_{2S}^* < x_{2N}^* \Rightarrow u_{x_{2S}} > u_{x_{2N}}$. Thus the numerator is less than zero and $\frac{\partial s^*}{\partial \phi} < 0$.

The numerator for $\frac{\partial x_{1}^*}{\partial \phi}$ is equivalent to the second, third, and fourth terms in parentheses (and without the negative sign) in $(4.3)$ multiplied by $p^2 v_{y_2Ny_2N}$. By the concavity of $v$, $\frac{\partial x_{1}^*}{\partial \phi} > 0$.

Similarly, the numerator for $\frac{\partial y_{1}^*}{\partial \phi}$ is equivalent to the second, third, and fourth terms in parentheses (and without the negative sign) in $(4.3)$ multiplied by $p u_{x_1x_1}$. By the concavity of $u$, $\frac{\partial y_{1}^*}{\partial \phi} > 0$. From these results, it is also clear that $| \frac{\partial x_{1}^*}{\partial \phi} | < | \frac{\partial s^*}{\partial \phi} |$, and $| \frac{\partial y_{1}^*}{\partial \phi} | < | \frac{\partial s^*}{\partial \phi} |$ but whether $| \frac{\partial x_{1}^*}{\partial \phi} | + | \frac{\partial y_{1}^*}{\partial \phi} | \geq \frac{\partial s^*}{\partial \phi}$ or $| \frac{\partial s^*}{\partial \phi} |$ depends on $p$. If $p < 1$, then $\frac{\partial s^*}{\partial \phi}$ is greater in magnitude. If $p = 1$, then $\frac{\partial s^*}{\partial \phi}$ is equal to the sum of the other two pieces. If $p > 1$, then $\frac{\partial s^*}{\partial \phi}$ is smaller in magnitude. What is important is that $\frac{\partial s^*}{\partial \phi}$ is greater in magnitude than either single element thus the consumer chooses to give up consuming both $x$ and $y$ in order to store units of good $x$ for future consumption.

The numerator for $\frac{\partial x_{2N}^*}{\partial \phi}$ is given by

$$u_{x_{2N}s} \left( u_{x_1x_1} + p^2 v_{y_1y_1} \right) \left( u_{x_{2S}s} + \tilde{p}^2 v_{y_2Sy_2S} \right) \left( u_{x_{2N}} - u_{x_{2S}} \right). \quad (4.4)$$

Once again, the concavity assumptions and knowledge that $x_{2S}^* < x_{2N}^*$ reveals that $\frac{\partial x_{2N}^*}{\partial \phi} > 0$. 

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The numerator for $\frac{\partial y_{2N}}{\partial \phi}$ is simply the negative of the numerator for $\frac{\partial x_{2N}}{\partial \phi}$ multiplied by $p$. This makes sense because the change in the consumption of good $y$ must be equal to the value of the change of the quantity of good $x$ purchased in that period. Thus, $\frac{\partial y_{2N}}{\partial \phi} < 0$.

The numerator for $\frac{\partial x_{2S}}{\partial \phi}$ is given by

$$u_{x2S} \left( u_{x1x1} + p^2 v_{y1y1} \right) \left( u_{x2N} + p^2 v_{y2Ny2N} \right) \left( u_{x2N} - u_{x2S} \right), \quad (4.5)$$

By concavity of $u$ and $v$ and knowledge that $x_{2S}^* < x_{2N}^*$, then $\frac{\partial x_{2S}}{\partial \phi} > 0$. The numerator for $\frac{\partial y_{2S}}{\partial \phi}$ is equivalent to the negative of the expression in (4.5) multiplied by $\tilde{p}$. Thus, $\frac{\partial y_{2S}}{\partial \phi} < 0$. 

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