

Advertising Expenditure and Price as Joint Indicators of Product Quality Perceptions: A Perspective From Game Theory

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[Abstract] The purpose of this study was to investigate the relationship between advertising expenditure and price level as joint signals of product quality in marketing practices and consumer perception research. This study, based on a sound literature review, utilizes game modeling from a signal economic perspective to examine whether advertising and price can be substantially used to determine product quality. There is often insufficient information on product quality before consumers make their purchases, and advertising and price indeed signal product quality. Situational decision making is what manufacturers consider doing, and this study combines the 4P strategy in the Product Life Cycle (PLC), and provides a skeleton description of managerial implications.

[Keywords] signal theory; game theory; advertising; price; product quality

Introduction

The marketing mix model, also known as the 4 Ps: Product, Price, Place, and Promotion, can be used by marketers as a tool to assist in defining marketing strategy. The function of the marketing mix is to help develop a package that will not only satisfy the needs of the customers within the target markets, but also simultaneously maximize the performance of the organization. Understanding consumer behavior and accomplishing the purpose of fueling consumer desire is important, especially for the service industry. Actually, an appropriate marketing mix can increase the value addition of products.

Product quality has been seen as one of the important attributes influencing customer purchase decisions (Birtwistle & Clarke, 1998; Chen, et al., 2007; Garvin, 1984; Jeong & Lambert, 2001; Wells, et al., 2011). Holbrook and Corfman (1985) stated that perceived quality is the consumer opinion of a product's ability to fulfill his or her expectations. Most research has focused on perceived quality, a more important factor than others in terms of repurchasing intentions (Babakus, et al., 2004; Zeithaml, et al., 1996). The situation of information asymmetry pervasively existing between firms and consumers causes consumers to make buying decisions based on their perceived product quality, which is often signaled by price or advertising (Chiang, et al., 2006). Signaling theory provides a framework for understanding how extrinsic cues can be used by sellers as a signal to convey product quality information to consumers, reducing uncertainty and facilitating an accurate quality assessment and purchase decision (Pavlou, et al., 2007; Wells, et al., 2011; Yen, 2006).

Signal theory is an advanced concept of game theory. Many economic situations with asymmetric information can be modeled as signaling games. A signaling game is an incomplete-information leader-follower game in which only the leader has private and perfect information. The leader moves first, and then the follower observes the leader's action before choosing his/her own action (Fudenberg & Tirole, 1991). Even simple signaling games can have sequential equilibria that are considered "unintuitive". For example, in Spence's (1973) well-known model of the job market, workers with good information about their own ability levels have to decide whether to obtain additional education or not.

Generally speaking, with different products in different categories, there is evidence that a product launched with a high quantity of advertising will produce a higher product quality rating than a product launched with a low quantity of advertising, as a high quality rating has a positive influence on advertising effect and sales (Beem & Ewing, 1954; Marquardt & McGann, 1975). A product with a high

level of media exposure is usually regarded as being of high quality (Birger, 1990; Thomas, et al., 1998). Even today, rich information communication in the online shopping website is seen as a signal, a kind of extrinsic cue, helping online consumers assess high perceived product quality (Gregg & Walczak, 2008), even helping online consumers make quality-adjusted price comparisons of non-homogeneous products across internet retailers to facilitate a purchase (Kamakura & Moon, 2009).

When consumers intend to buy a non-durable product, they usually rely on price or quality as a factor in decision making. Some tend to associate a higher-priced product as the one with higher quality, while others use the quantity of advertising in their judgment (Monroe & Krishnan 1985; Teas & Agarwal 2000; Zeithaml, 1988). Therefore, price and advertising are joint signals of quality (Hertendorf & Overgaard, 2001). A firm attempts to optimize its pricing and advertising policy to signal its product quality. However, the real quality of products is only informed by the firm, whereas the customer is uninformed. The game-theoretic way to analyze this context helps to build a model of the behavior of two parties and to look for behavior that forms equilibrium of the model (Fudenberg & Tirole, 1991). The purpose of this study is to utilize game modeling from a signal economic perspective to examine if advertising and price can be used to determine product quality. This entails making decisions regarding substantive customer quality perception attributes that are known to be important to customers and that relate to product or marketing performance and availability. Some managerial implications are also suggested.

Advertising Outlay and Price as Quality Signals

Zeithaml (1988) believed that price is not an external characteristic of specific products, but rather a generalized quality indicator across product categories. Price and advertising are the external data most often used in studies. They are symbolic attributes most readily associated with product quality by consumers. In the previous research, first, in simple terms, the level of advertising states that since most product attributes are decided only when products are being used (as the “experience goods” referred to by Nelson, 1970), a high level of advertising repetition is considered as a signal of a high quality product. A consumer may infer that the high cost of advertising reflects the manufacturer’s commitment to the product. The product quality, however, is not directly presented. Second, price has been studied the most, and Monroe and Krishnan (1985) deduced that most price-quality recognition studies in the past have been scrutinized. When the brand name and level of advertising are evidence of product quality, a consumer tends to use these cues instead of price. Erdem, et al. (2008) proposed that both prices and advertising, including advertising frequency and advertising content, signal brand quality, while the role of advertising frequency in signaling quality is also significant, but it is less quantitatively important than price.

From an economic perspective, manufacturers often use price and advertising expenditure as the signal of quality (Milgrom & Roberts, 1986). When the price exceeds the full information case, manufacturers will use above average levels of advertising (Thomas, et al., 1998). Some may “burn” enough money to signal quality (Birger, 1990). Fluet and Garella (2002) have similar findings that if there is price competition, advertising is necessary to signal quality.

Advertising Outlay as a Quality Signal

Nelson (1970, 1974) separated products into searching goods and experience goods. The quality of searching goods can be observed before purchasing, therefore, advertising can only directly provide product information on content. However, the quality of experience goods is non-observable and can only be obtained after purchase. Manufacturers, therefore, inform consumers of the non-tangible product attributes (such as the delicate manufacturing process or enterprise image reinforcement) to attain the goal of signaling high quality.

The online market today for experience products represents a challenge for online sellers as the technology-mediated environment makes it more difficult to convey the experiential attributes (such as taste, sound, fit) associated with such products (Wells, et al., 2011). Nelson’s studies provide the key insights that specific brands of experience goods are able to relay high product quality signals through

advertising. Nelson also focuses on “repetitive purchases”. High quality products entice repetitive purchases by consumers. A buyer who is uncertain about product information will choose to positively react to the high quality signals from the advertising, and make the purchase.

Kihlstrom and Riordan (1984) theorized a comparable model using non-informative advertising to signal quality. They also formalized Nelson’s (1970, 1974) idea of repetitive purchasing through advertising, and called it the “Nelson advertising equilibrium”. This study found that advertising may be an unnecessary expenditure, and low quality producers do not find incentives to spend extra money on advertising. Advertisements may also be interpreted by consumers as messages being conveyed by manufacturers. When advertising expenditure increases to higher than the appropriate price in terms of product quality, the extra cost will be shifted to consumers and be reflected in the product price.

When advertising expenditure is a signal mechanism, it is also considered as a dissipative expense (Milgrom & Roberts, 1986). Because only large manufacturers are capable of investing large sums in dissipative advertising, consumers often associate high advertising expenditure with product quality. In sum, since advertising may signal product quality (Bagwell & Ramey, 1988; Barigozzi, et al., 2009; Nelson, 1974; Milgrom & Roberts, 1986), the objective for advertising expenditure, then, may be to relay quality signals, or to raise consumer’s product awareness.

Price as a Quality Signal

When focusing on price as a quality signal, from an economic perspective, high quality producers should raise the price to signal quality. Bagwell and Riordan (1991) studied price as a quality signal, and found that a high price can be an effective signal, because loss of sales volume due to high prices is less damaging to high cost products. Su (2007) stated that price as a signal for online consumers to make e-Retailer choice based on value expectation to make the purchase.

In general, the costs of high quality products and peripherals are higher for high quality manufacturers. Low quality manufacturers then have an incentive to market products with the same high prices. Eventually high prices will limit or lower sales volume and will prove to be more unfavorable for lower quality manufacturers. This is because after information diffuses, consumers learn the quality (for example after purchasing), and are unlikely to spend more than they should for lower quality products. High quality manufacturers, therefore, should set an even higher price, so that low quality manufacturers cannot price mimic, but rather set the price at the full information level (Bagwell & Riordan, 1991; Zhao, 2000).

Signaling Game Modeling

Zeithaml (1988) considered price, brand names, and advertising level to be external cues of quality signals recognized by consumers, and argued that these attributes are related, but not part of the product itself. Due to incomplete information, consumers are uninformed on quality before purchasing, and will often have different views to determine product quality by price and advertising expenditure. Therefore, for high quality products, manufacturers, through advertising, demand high prices for a high cost and high quality market. Without advertising, manufacturers attract low value customers who do not insist on brand or quality, while consumers have high (V_H) and low (V_L) assessments of different brands of the same product. The price consumers are willing to spend will be based on whether or not the manufacturers have built brand recognition through advertising. Based on this concept, when neither manufacturers nor consumers are aware of their approaches due to insufficient information, manufacturers’ behavior may be explained with the application of gaming models.

The Prisoner Dilemma Game of Price Competition Between Manufacturers

One of the most well known gaming theories is the Prisoner Dilemma game model, which is also the most important and widespread illustration of Nash equilibrium used by most modelers (Rasmusen, 2001). In a market structure where minor manufacturers cooperate and compete at the same time, the competitor’s market strategy is often speculated, and a counter strategy is formulated in order to make a profit. Prisoner Dilemma can be used to explain the competition between two manufacturers. As shown in Table

1, supposing the competition lasts only one phase (only one phase is discussed here), the Nash equilibrium of simple strategy is (40, 40) when both adopt a high price strategy. If several phases are examined, several strategies may be applied (Table 1):

- i. One of the two manufacturers recognizes the consequence of breaking the equilibrium and may gain a profit of 60. This equilibrium will be disturbed by introducing a low price strategy for one manufacturer and a high price strategy for another. The equilibrium is (24, 60) or (60, 24). The promotion period at retail stores is a typical illustration of this situation.
- ii. After customers are attracted by one manufacturer’s low price strategy, causing the profit to slip to 24, the other has to follow, and the profit is now 32. At this time both manufacturers adopt a low price strategy. Wholesaler and electronic stores’ “low price guarantee” and “price difference refund” are a case in point. They rely on consumers to be the guardians of price, and engage in equilibrium at a (32, 32) low price strategy.
- iii. Collusion between manufacturers to raise the price, while still “enforcing” their lowest price guarantee. Their justification may be an increase in the cost of materials, having an impact on the whole industry. The equilibrium returns to (40, 40). Consumers stay between the high and low price, and are often the ones to lose profit when information is incomplete.

Table 1. Prisoner Dilemma Game of Price Competition

	II	18	12
I			
18		40, 40	24, 60
12		60, 24	32, 32

Note: 18 (dollars) is a high price strategy, and 12 (dollars) is a low price strategy. The payoff set of (x, y) in the table represent the profits for manufacturers I and II, respectively.

When the product value is equal to or higher than the price, consumers are satisfied, even though they paid a high price. In other words, consumers are willing to accomplish economic equilibrium since price and advertising are general signals for consumers to determine the quality of products before purchase.

Employing the Battle of the Sexes Game to Illustrate the Effect of Price

The Battle of the Sexes game illustrates a conflict between a man who wants to go to a football game and a woman who wants to go to a ballet (Fudenberg & Tirole, 1991; Rasmusen, 2001). This game has two pure strategy Nash equilibriums, one where they both go to a football game and another where they both go to a ballet, namely (F, F) and (B, B) payoffs. Their payoffs are given in Table 2.

Table 2. “Battle of the Sexes” Game

	Woman	B	F
Man			
B		1, 3	0, 0
F		0, 0	3, 1

Note: B is a decision to go to a ballet, and F is a decision to go to a football game. The value of (x, y) in the table represents the profit for a man and a woman, respectively.

Table 3. Burning Money Game Considering Cost

	Woman	B	F
Man			
B		1-1, 3	0-1, 0
F		0-1, 0	3-1, 1

The following employs the Battle of the Sexes game to demonstrate the influence of merchandise price on

consumer’s perception. Manufacturers are inclined to profit from a high price of the product, and consumers are inclined to purchase high quality low priced products. Before products go into the market, manufacturers decide on the option for advertising (increased cost) before setting a high price (P_H) or a low price (P_L). If the quality of the same product remains the same (fixed cost), a trading game results from the price and consumer evaluation, as shown in Table 4.

Table 4. Trading Game of Different Prices Between Manufacturers and Consumers

	Consumer		
		P_L	P_H
Manufacturer			
P_L		1, 3	0, 0
P_H		0, 0	3, 1

Note: P_L is a low price strategy, and P_H is a high price strategy. The values of (x, y) in the table represent the profits for the manufacturer and the consumer, respectively.

- (PH, PH) - Manufacturers set a high price. The product is sold to consumers who have a high evaluation (VH) of the product; thus, there is an increased marginal profit for manufacturers. Because consumers pay a higher price, it is less cost effective for them. The reward for manufacturers and consumers is (3, 1).
- (PL, PL) - Manufacturers set a low price. The product is sold to consumers who have a low evaluation (VH) of the product, and the manufacturers earn less profit from the product. The reward for the manufacturers and the consumers is (1, 3).
- (PL, PH), (PH, PL)- Manufacturers set a high price. Low valuation consumers cannot purchase with a low price, and high valuation consumers are not attracted to low price products. The reward is (0, 0).

There are also two pure strategy Nash equilibriums, one where the trading is completed with a high price and another where the trading is completed with a low price, namely (PH, PH) and (PL, PL) payoffs.

Applying the Burning Money Game to Illustrate Advertising Effect

The process of elimination is called iterated strict dominance. As opposed to iterated strictly dominance, iterated weak dominance shows different solutions through different orders of deletion, for which the Burning Money game is the most striking example (Fudenberg & Tirole, 1991). Players 1 and 2 are going to play a simultaneous game of coordination with several pure-strategy equilibriums that are all better than not coordinating. However, before the game is played, some players have the possibility to publicly burn a small amount of utilities (Van Damme, 1989). They are allowed to send a costly message that can be called the “burning money” announcement since sending costly messages has no literal meaning.

Ben-Porath and Dekel (1992) investigated the consequences of allowing some players to signal future costly actions before the game is played. They found that if only one player in a two-party game can signal, then, according to iterated weakly dominated strategies, he/she would select his/her most preferred outcome. Moreover, the player does not have to incur any cost to achieve this.

We illustrate the game considering a consumer market setting in which players have the possibility to burn money. Advertising a brand sometimes needs to be achieved by “burning” enough money. It serves as a quality signal (Birger, 1990), as well as an assurance of quality by the manufacturers. This illustrates a game of burning money (Table 5).

The following employs the burning money game to demonstrate the model accounting for the manufacturer-consumer dynamics (Fudenberg and Tirole, 1991). When a manufacturer decides on advertising spending, payoff of consumers conducts the decision strategy of consumers. Whereas the manufacturer decides not to spend on advertising, the decision strategy is conducted by Payoff of manufacturers. This game approach has a contingent decision instead of general equilibrium. Before manufacturers set a high (P_H) or low (P_L) price, they will decide on advertising spending (increased cost) in order to signal quality and estimated price (advertising cost = 1, the payoff effect of manufacture = -1). This forms a game of Burning Money in Table 5 and the extended game is presented as Table 6.

Table 5. Burning Money Game in Product Advertising

	Consumer		
		S-P_L	S-P_H
Manufacturer			
P _L		1-1, 3	0-1, 0
P _H		0-1, 0	3-1, 1

In Table 6, the first component of the consumer’s strategy is how to play if the manufacturer burns (advertising) and the second component is how to play if the manufacturer does not burn. Take examples, the first cell depicts the situation that the manufacturer advertises and set low price (P_L), and consumer’s first S_{PL} strategy conducts his (S_{PL}, S_{PL}) strategy, and hence the payoff set equal to (P_L=1-1, S_{PL}=3) as shown on Table 5. Below the first cell, its neighbor cell depicts the situation that the manufacturer advertises and set low price (P_H), and consumer’s first S-P_L strategy still conducts his (S_{PL}, S_{PL}) strategy, and hence the payoff set equal to (P_H=0-1, S_{PL}=0) as shown on Table 5.

Table 6. Extended Game of Burning Money in Product Advertising

	Consumer				
		S_{PL}, S_{PL}	S_{PL}, S_{PH}	S_{PH}, S_{PL}	S_{PH}, S_{PH}
Manufacturer					
Advertising, Low price (P _L)		1-1, 3	1-1, 3	0-1, 0	0-1, 0
Advertising, High price (P _H)		0-1, 0	0-1, 0	3-1, 1	3-1, 1
No advertising, Low price (P _L)		1, 3	0, 0	1, 3	0, 0
No advertising, High price (P _H)		0, 0	3, 1	0, 0	3, 1

In this extended game, the manufacturer’s strategy (advertising, low price (P_L)) is strictly dominated by (no advertising, high price (P_L)). Therefore, at the next round of iteration consumer’s best response to manufacturer’s advertising strategy is to play S_{PL} strategy. That is, once (advertising, low price (P_L)) strategy is deleted, S_{PL} strategy is strictly dominated by S_{PH} strategy. After two rounds of iteration (advertising, high price (P_H)) strategy guarantees manufacturer a payoff of 3-1=2 and strictly dominates (no advertising, low price (P_L)) strategy. Hence after three rounds of iteration, consumer should conclude that even though manufacturer does not advertise, High price (P_H) is certainly played and get the payoff of 3. Based on this finding, advertisement is an option to announce product quality, however, high price would be adopted to signal product quality due to profit consideration.

Signaling Game and Separating Equilibrium

The Signaling game, the simplest game of incomplete information, is presented as Player 1’s action may reveal information about his type (for example tough or weak setting) to Player 2. Player 2 observes Player 1’s action (for example high- or low-level strategy) rather than his type, and chooses his strategy. A widespread taxonomy occurs in the equilibrium of signaling games: separating equilibrium and pooling equilibrium. Separating equilibrium is an equilibrium in which the two types of leader players choose two different actions in the first period, and the follower player might observe and establish a belief that the leader player behaves according to his type (Fudenberg & Tirole, 1991; Rasmusen, 2001). The follower player will have the complete information of the leader player’s type and action in the second period:

$$Probability (type 1 | action 1) = 1 \text{ and } Probability (type 2 | action 2) = 1$$

In general, separating equilibrium is a form of contingent decision which emphasizes that various contingents will bring out different game equilibriums.

Kihlstrom and Riordan (1984) focused on Nelson’s finding regarding experience goods quality signals, and described it as the “Nelson advertising equilibrium.” Furthermore, they analyzed whether advertising is excessive, and a way in which manufacturers imbed advertising expenditure into price, thereby passing on the cost to consumers, implying that low and high quality manufacturers have different equilibrium reactions toward advertising. Milgrom and Roberts (1986) formalized Nelson’s (1970, 1974)

theory: For both advertising and price signal quality, due to cost considerations, only high quality manufacturers are able to set high prices and use massive dissipative advertising to signal the quality of newly introduced products:

Probability (high quality firm | high price and massive ads) = 1.

Hertzendorf and Overgaard (2001) showed that price separation is impossible if the vertical differentiation is small, while adding dissipative advertising ensures the existence of separating equilibriums. In other words, high price and advertising effectively separate high and low quality competitors. Zhao (2000) alleged that when consumers are uncertain about quality, advertising and price differentials may also cause the existence of separating equilibriums.

Nelson (1974) pointed out that most advertising of experienced goods is not of the informative type – that is it provides no direct information on product quality. Because quality of experience goods is known only after consumption, non-informative advertising appears to link quality and advertising. This kind of advertising is referred to by Milgrom and Roberts (1986) and Kihlstrom and Riordan (1984) as the signal mechanism. This mechanism causes the existence of separating equilibriums by providing a relationship between “quality” and “profit created from signal”.

Linnemer (2002) focuses on the proportion of uninformed and informed consumers as grounds for selecting the signal mechanism. If the proportion of informed consumers is low, quality is signaled only through a high price. However, if this proportion is moderate, quality is signaled by both advertising and price. This is another illustration of separating equilibrium.

Pooling Equilibrium

Pooling equilibrium is an equilibrium in which the two types of leader players choose the same actions in the first period, and the follower player does not update his/her beliefs when observing the equilibrium action (Fudenberg & Tirole, 1991):

Probability (type 1 | action 2) = p , $p \in (0,1)$.

For an advertising pooling equilibrium to exist, consumer valuation for high quality, advertising cost, prior probability that quality is high, and inaccuracy of the buyers' pre-purchase information must be sufficiently high (Moraga-González, 2000). Informative advertising exists only in pooling equilibrium because price is a signal of quality. After consumers observe product prices and learn the true quality, advertising expenditure is unnecessary. When non-informative advertising signals quality, consumer's knowledge of quality may come from the price (if separating equilibrium exists) or from the advertising (if advertising pooling equilibrium exists). Therefore, for advertising and price to signal quality, pooling equilibrium or separating equilibrium must exist.

Fluet and Garella (2002) were concerned with the existence of separating equilibriums in a duopoly, and showed that separating equilibriums without advertising requires that the price set by the high quality firm be greater than the reservation price of the low quality product. It is positive signaling only for the condition that the quality differentials are large. Advertising, when quality differentials are small, is necessary to obtain separation of good from bad quality. Advertising in the form of conspicuous unit cost increments may efficiently improve the signaling effect.

Discussion and Managerial Implications

There is often insufficient information on product quality before consumers make their purchases, and advertising and price indeed signal product quality. Through various game modeling analyses, consumers tend to react to different signals, such as advertising and price, which would alter their purchase decision when information is incomplete. Pooling and separating equilibriums for advertising and price signals work differently with varying quality information levels (Spence, 1973). In summary, situational decision making is what manufacturers consider doing, and this study combines the 4P strategy in the product life cycle (PLC), and provides a skeleton description of managerial implications.

The characteristics of these two PLC stages trended not only the competition and product are fewer, but also that the consumers need to be educated and made market segmentation. In this uninformed stage,

separating equilibriums explains a probability distribution of existing manufacturers for consumers. After observing the higher advertising expenditure and product price of high quality manufacturers than those of low quality manufacturers, consumers rearrange their probability distribution based on the quality of manufacturers, and form a separating equilibrium. The advertising expenditure and price of both high and low quality manufacturers signal a positive quality for consumers, and therefore quality differentiation is apparent. High valuation consumers purchase high quality products, and low valuation consumers purchase low quality products. The number of competitors at this stage reaches the top and begins to decrease, and in general the product is no longer fresh for consumers. The aims of advertising outlay and price signal are to maintain the quality image and perceptions.

Future Research

The existing literature on advertising and price as quality signals has not considered the game modeling theory perspective. The main focus has been on the inference of signal theory. This study has presented several perspectives on various kinds of game modeling, and composes a conceptual direction for future research. In this research, we have not attempted to compose an exploration with samples, but future studies could clarify the following directions: First, the Battle of the Sexes and Burning Money can be further explored; second, non-structured discussion with consumers and the content analysis process may provide insights into advertising, product quality and price recognition structures; third: after the indirect methods mentioned above are conducted, studies can be designed to further evaluate the correlation between advertising, price and quality signals.

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