



## Incorporating Behavioral Anomalies in Strategic Models

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### *Abstract*

Behavioral decision researchers have documented a number of anomalies that seem to run counter to established theories of consumer behavior from microeconomics that are often at the core of analytical models in marketing. A natural question therefore is how equilibrium behavior and strategies would change if models were to incorporate these anomalies in a consistent way. In this paper we identify several important and generalizable anomalies that modelers may want to incorporate in their models. We briefly discuss each phenomenon, identify a key unresolved issue and outline a research agenda to be pursued.

**Keywords:** marketing strategy, game theory, reference dependence, fairness, confirmatory bias

## Introduction

Strategic models in marketing focus on predicting/explaining firms' strategies given the reactions of customers and competitors. In these models, modelers prescribe the preferences, objective functions, and the constraints the players face as well as the rules of the game they play. These fundamental building blocks are almost always based on the microeconomic theory of consumer and firm behavior, with the equilibrium strategies determined using the standard solution procedures of game theory. The standard assumptions are that agents (firms and customers) have well defined preferences over the outcomes that are based on the choices they make, and that they act in their self interest maximizing their own welfare subject to the constraints they face.

The seminal articles of Kahneman and Tversky (1979), Tversky and Kahneman (1974, 1991) have advanced an alternative theory to the microeconomic foundations of consumer behavior, and in turn, consumer behavior researchers have documented a variety of deviations from classical utility maximizing behavior. These deviations, which we refer to as anomalies, have been demonstrated in laboratory experiments as well as in field studies. Yet, little is known about the effect of these anomalies on firms' strategies, both in a positive sense—whether their behavior already reflects these anomalies—and in a normative sense, whether they ought to. The literature that incorporates behavioral considerations in strategic models is a small one.

In this paper, we consider three anomalies that have the promise of improving the insights from marketing models: reference dependence, fairness, and confirmatory bias. We review extant analytic models that have incorporated these behaviors and suggest future directions for research. Our goal is to understand how the implications of strategic models would change if one incorporated deviations from classical utility-maximizing behavior.

We recommend that research proceed along two complementary directions: document a richer set of field examples of anomalies to serve as a basis for analytic models and develop and test the models that incorporate these anomalies. Model development and empirical analyses are complementary and should energize and refine each other (Bass, 1995; Ehrenberg, 1995).

### *Reference Dependence*

Camerer et al. (1997) provide evidence that the labor supply decisions of New York City cab drivers seem to be made on a day-to-day basis using daily income targets. Drivers set a daily earnings target and then quit work when they reach that target. In prospect theory terms (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992), the income target is the reference point, and the cabbies' behavior reflects a utility function that is strongly concave around the target: a strong distaste for falling short of the target level of earnings (loss aversion) and a low marginal utility for earnings above the target. Daily income targeting

runs counter to the economic-theory notion of intertemporal substitution between income and leisure, and the idea that labor supply curves should slope upward: drivers working long hours on bad days just to fulfill a pre-set earnings quota and quitting early on good, high-wage days seems irrational. Prospect theory and the economic theory of labor supply thus predict opposite signs for the correlation between hours worked and the hourly wage.

Camerer et al. (1997) found that this correlation was strongly negative for inexperienced drivers in two of their three data sets, consistent with reference dependence based on daily income targets. For experienced drivers, the correlation was positive but not significantly different from zero in two data sets (the other data set continued to show negative correlation), suggesting that drivers who stay with the job learn through experience to shift toward working harder on days when per hour earnings are highest. But overall, the general lack of a strong positive correlation between hours worked and the hourly wage suggests that reference dependence may be important enough in labor supply decisions to change the direction of labor supply curves (from upward-sloping to downward-sloping).

#### *Fairness*

Dawes and Thaler (1988) tell the following story: “In the rural areas around Ithaca, it is common for farmers to put some fresh produce on a table by the road. There is a cash box on the table, and customers are expected to put money in the box in return for the vegetables they take.” Presumably, if someone takes some vegetables without putting any cash in the box, no one will find out, and if enough people did that the farmer wouldn’t be so trusting. Still, the fact that Ithaca farmers continue this honor-based system suggests that there are enough fair-minded people, in Ithaca at least, to make it economically viable.

Experiments with the ultimatum game (Thaler, 1988) show that fair-minded people do not just reciprocate trust, but they also engage in another form of tit-for-tat behavior: punishing those who are being unfair even if it is not in their self-interest. In this game, between a “proposer” and a “decider,” the proposer proposes a particular division of X dollars and the decider either accepts or rejects the proposal. If the decider accepts, the money is divided between the two according to the proposal; if s/he rejects, no one gets anything. If the players cared only about their economic self-interest, the proposer would simply offer a penny to the decider and the decider would accept (a penny is better than nothing). However, numerous experiments show that this is not what people do. Typically, proposers offer to split the money evenly, realizing that deciders will reject offers perceived to be unfair.

Fairness-motivated behaviors are not limited to individuals. As Kahneman et al. (1986a) point out, “there is a significant incidence of cases in which firms, like individuals, are motivated by concerns of fairness.”

#### *Confirmatory Bias*

Deighton (1984) found evidence for confirmatory bias in how consumers evaluate product quality information. One group of experimental subjects saw a print advertisement

promoting the quality of Ford automobiles followed by data about frequency of repairs of various brands while another group of subjects only saw the frequency-of-repair data. The analysis of pre- and post-measures of subjects' estimates of reliability of cars showed that the former group of subjects rated Ford cars to be more reliable than the latter group. These results are consistent with the idea that the subjects who saw the print advertisement promoting the quality Ford cars formed an initial hypothesis that Ford cars had high reliability, which then shaped the way they interpreted the subsequent data.

### **Research Agenda**

To incorporate behavioral anomalies in strategic models we need to know how such biases affect preferences and choices so that these can be incorporated into a choice model or a demand function. We also need to know if and how the behavioral constructs such as the reference point, fairness etc. are affected by firms' actions or consumer's choices and what assumptions about their influence, relative to marketing variables, on choices need to be made. Once a choice model or a demand function is derived incorporating these, a modeler can use traditional analytical tools to derive equilibrium strategies. To achieve this goal the following issues seem to be relevant for further research:

1. How prevalent and robust are these anomalies? What are their implications for firm and market behavior?
2. How significant are these anomalies in the presence of multiple marketing variables such as price, promotions and advertising?
3. Have we seriously attempted to extend existing "rationalistic" models and frameworks to explain the anomalies that have been documented?
4. Is it possible to develop internally consistent non-rational models of consumer and firm behavior to account for the anomalies, which also lead to realistic equilibrium behavior on other dimensions?
5. What is an appropriate metric to judge the value of a model that is augmented to reflect anomalous behaviors? If the firm and market-level predictions of these models are no different from the rational models is there value in the new approach?

We examine these questions in the context of the three anomalies identified earlier.

### *Reference Dependence*

In applying prospect theory to model reference dependence, analytical and empirical modelers are faced with the following modeling issues:

1. How are reference points determined? For example, in Camerer et al. (1997) taxicab story, why do the cab drivers use a target daily income instead of a target daily hours-worked? In a product context, is the reference point determined at the level of attributes

- (color, package size, price, etc.) or at the level of the whole product, at the category level (cereals), or at the brand level (Kellogg's Cornflakes)?
2. How do reference points change or evolve from one purchase occasion to another? What psychological principles govern the evolution of reference points?
  3. If reference points are different for different consumers is there a theory that explains the difference?

Marketing researchers have offered two sources from which people may derive reference points. One is based on external stimuli such as list prices and the other is based on personal memory of past prices. Briesch et al. (1997) find support for a model with exponential smoothing of past brand price,  $p_{t-1}$ :

$$r_t = \alpha r_{t-1} + (1 - \alpha)p_{t-1} \quad \text{where } r_t \text{ is the reference price in period } t. \quad (1)$$

A question remains as to how to interpret the past price in (1): is it the last price paid or last price offered? If the former, then each consumer may have a different reference price for each brand. For example, price-sensitive people who buy cheaper brands may have a lower reference price than price-insensitive people. Also, there is no reference price if a brand has never been purchased before. In contrast, last price offered always exists, and one could argue that such prices, especially when advertised, may be very salient and affect customers' price perceptions even if they do not purchase.

In the packaged goods categories several attempts have been made to document reference dependence based on past prices. While there is support for reference dependence, the results on loss aversion are weak at best. For example while Hardie et al. (1993) document loss aversion, subsequent papers by Bell and Lattin (2000) and Chang et al. (1999) point out a methodological weakness in prior studies and show how correcting for this either weakens or eliminates the loss aversion finding.

Two papers that have explored the implications of past-price-based reference prices for equilibrium pricing policies are Greenleaf (1995) and Kopalle et al. (1996). Greenleaf (1995) considers a monopolist selling a single product and assumes that the reference price process is (1). Kopalle et al. (1996) extend this analysis to a duopoly with multiple products. Both papers show that reference prices may lead to cyclical pricing by firms, providing a rationale for high-low pricing.<sup>1</sup> However, these results should be interpreted with caution. As suggested earlier, incorporating reference prices in analytic models may have undesirable consequences, such as a poorly behaved equilibrium. To see this, suppose aggregate demand is a function of both price and reference price,  $Q(p, r)$  and the reference price process is (1). If a firm offers an infinite price in period  $t - 1$  then the demand in that period is zero, but the reference price in period  $t$  becomes infinite. If  $dQ(p, r)/dr > 0$  for all  $r$ , the firm is able to sell an infinite number of units at finite prices in period  $t$ , which leads to infinite profits.<sup>2</sup> A similar problem occurs in a product line context if the reference price equals the current price of the last brand purchased. If brand  $j$  is the reference brand then setting an infinite price for brand  $j$  leads to an infinite reference price and infinite demand for all other brands.<sup>3</sup>

An alternative approach to modeling the reference price process is to explicitly model the consumer inference process. As an example of this approach, assume heterogeneous product

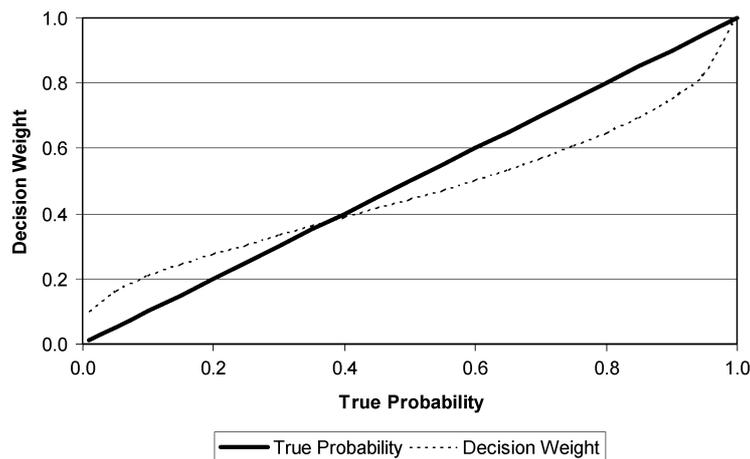
valuations,  $v$ , that vary between high ( $H$ ) and low ( $L$ ) and a reference price process given by:

$$r_t = \alpha(p)r_{t-1} + (1 - \alpha(p))p_{t-1}. \quad (2)$$

The weight given to past prices,  $\alpha(p)$ , is proportional to the expected fraction of consumers who purchase at price  $p$  and  $\alpha(p) = 0$  for all  $p > H$ . The intuition for this model is that consumers realize that the only reason to offer a price greater than  $H$  is to manipulate the reference price. Thus, “smart” consumers will give zero weight to all prices greater than  $H$ . For example, mattress stores often list very high regular prices and few consumers believe that any consumers purchase at these prices. Consumers in the proposed model formulation disregard high prices in a similar fashion.

Past prices also might not be equally weighted (or exponentially smoothed) because some prices are simply more salient. Certain prices, for example, might be more memorable, simply because they are outside the norm or some numerical benchmark (e.g., Kahneman and Miller, 1986). To illustrate, a camera buff might be more likely to recall a price drop from \$ 1,199 to \$ 999, than the previous price drop from \$ 1,399 to \$ 1,199, simply because the price has now cracked the \$ 1,000 barrier. A finding from another field illustrates this idea. Heath et al. (1999) found that the chance of exercising a stock option doubled after the stock price passed a 12-month high, suggesting that the high price serves as a reference point and that investors are in the domain of losses until the stock price exceeds this historical reference point.

Of course, reference prices may not be based on current or past prices but rather on expected future prices. Thus, the reference price might be the expected price on the next purchase occasion. Not only is this approach consistent with standard economic approaches, it allows modelers to incorporate another key feature of prospect theory: the probability weighting function. When outcomes are uncertain, as in the case of future prices, prospect theory assumes that customers transform objective probabilities into *decision weights* by means of a probability weighting function,  $\pi(\cdot)$ . The probability weighting function is typically inverse S-shaped, and hence overweights low probability events and underweights more certain events as shown in the following figure. Thus, extreme events, either the



worst or best events, are overweighted relative to their probability and intermediate events are underweighted relative to their probability. The *rank-dependent* representation used in cumulative prospect theory (Tversky and Kahneman, 1992) ensures that decision weights sum to one.

We are not aware of any analytic models in marketing that use the probability weighting function, though a number of parsimonious parametric specifications for the probability weighting function exist (e.g., Prelec, 1998; Gonzalez and Wu, 1999). Since the probability weighting function has implications for how consumers react to price dispersion, it could be fruitful to incorporate the probability weighting function into models of promotion and consumer search. Some interesting questions are: given firms' knowledge of consumers' overweighting small probability events, how should a firm determine the sequence of promotion and the associated promotional depth? How should a firm react to a deep discount from its competition? Can we better explain consumer search behavior by using a reference dependent utility function instead of an expected utility function?

In addition to reference price, reference dependence has also found applications in other contexts. Shalev (1998) incorporates reference dependence into repeated games, where the value of the previous payoff is a reference point for evaluating next period's payoff. In particular, he focuses on inter-period losses while disregarding the effect of inter-period gains. He shows that reference dependent utility functions are better predictors of behavior than expected utility. Barberis et al. (2001) study asset prices in an economy where investors derive utility not only from consumption but also from fluctuations in the value of their financial wealth. Investors are loss averse over these fluctuations and the degree of loss aversion depends on their prior investment performance. The model is used to explain observed historical patterns in asset prices. Balasubramanian and Tomak (2005) construct a mental accounting model of consumers who derive utility from consumption experience and disutility from payment experience. They show that a monopolist always benefits from knowing consumers preferences whereas in a duopoly a firm might have incentives not to share this knowledge with price setting managers.

### *Fairness*

In the finale of the NBC reality show "For Love or Money 2," aired on September 8, 2003, Erin had narrowed her choice down to either Chad or Wade who, in turn, each had to decide whether to choose Erin or to pocket one million dollars. Erin chose Chad, not knowing Chad's choice. If Chad had chosen Erin instead of the million dollars, Erin would pocket two million dollars without any obligation to Chad. Then, Chad could have possibly been left with nothing. As the drama unfolded, Chad chose Erin. Erin was so moved by Chad's decision to sacrifice the guaranteed one million dollars in a bid for her affection that she immediately promised Chad that she would give him \$ 500,000!

Real life is rarely so dramatic. However, many studies have established that acts of reciprocation are not rare at all. As summarized in Rabin (1993), people display three common behaviors, motivated by their sense of fairness. First, "people are willing to sacrifice their own material well-being to help those who are being kind;" second, "people are

willing to sacrifice their own material well-being to hurt those who are being unkind;" and third, "both motivations have a greater effect on behavior as the material cost of sacrificing becomes smaller." These fairness-motivated behaviors are robust and non-strategic in nature.

Although people might be motivated by fairness, most models do not incorporate such behavior directly via the utility function itself. Rather, economic models typically motivate fairness as arising from repeated interactions among self-interested agents. So, there are three questions. First, do we observe consumers and firms motivated by fairness considerations *even when* they know that they are unlikely to interact with the other party ever into the future? Second, assuming that is the case, how best to incorporate fairness into strategic models? Third, when two parties (say firm and consumers or manufacturer and retailer) interact repeatedly over time, does incorporating fairness consideration directly lead to more accurate predictions of the behaviors of the players?

In the past decade, economists have begun incorporating fairness into game-theoretical modeling (Rabin, 1993; Bolton and Ockenfels, 2000; Levine, 1998; Fehr and Schmidt, 1999). Their main objective has been to reconcile well-known game-theoretical predictions with outcomes from experimental economics that have challenged those predictions. These efforts have proven to be fruitful intellectual adventures, but here are many promising research avenues that marketing researchers can pursue. The most basic one is to document different manifestations of consumer fairness concerns in different marketing contexts through experiments. For instance, how do consumers react to a firm's price discrimination efforts? Laboratory experiments by Feinberg et al. (2002) show that loyal consumers' decision to stay with a service provider is affected by how the service provider rewards others to switch to the service as well as how the competitor rewards their own loyal consumers. The authors label these two effects "jealousy" and "betrayal," respectively. Another example is Amazon.com charging different customers different prices for movies. The firm argued that the price differences were random, a way of testing the market. But many buyers accused the online retailer of tailoring prices to consumer's characteristics—presumably charging more to those deemed less price sensitive. This suggests that even if the prices were random, the outrage of those who had paid a few dollars extra may reduce demand for a firm. On the other hand, consumers routinely accept price discrimination as a fact of life for airline tickets.

Motivated by these examples, there is a growing body of experimental research designed to understand what moderates consumers' sense of fairness when facing different pricing structures imposed by a firm. Bolton et al. (2003) provide an example of one line of research. They show that consumers, in addition to paying attention to seller's costs, also look at past prices and competitors' prices when evaluating price fairness. A second line of experimental research on fairness has been inspired by Kahneman et al. (1986a) notion of dual entitlement, which argues that fairness perceptions are governed by a belief that the firm is entitled to some reference profit while customers are entitled to a reference price. Interestingly, their experiments suggest an asymmetry—consumers will accept price increases due to cost increases, but don't expect equivalent price decreases when costs go down. The asymmetry in the response to cost shocks is not unusual and is well-documented for gasoline (Borenstein et al. 1997) as well as juice and cereal prices (Muller and Ray, 2004). Monroe (1990) suggests

that the prevalence of cost-plus pricing is driven partly by concerns about perceived fairness. Work by Nunes et al. (2004) suggests consumers pay more attention to variable costs than to fixed costs, and that they are averse to prices that are presumed to be considerably higher than the marginal cost.

Experiments such as these offer many managerial insights as to how a firm should structure, present, and adjust its prices to ease consumer fairness concerns. More work is needed to assess to what extent fairness concerns are manifested in real-world marketing

Incorporating fairness concerns into theoretical analyses offers many opportunities to develop normative strategic prescriptions. For instance, in the context of targeted pricing, if consumers are motivated by fairness to behave in some predictable ways, should competing firms interact with each other differently? Campbell (1999) showed consumers make inferences about a firm's motive and profit, which can lead to judgments of unfair pricing practices and exploitation. These concerns, in turn, may lead to firms adjusting their targeting strategies in the direction of no targeting or more defensive targeting.

Channel research is another area that can benefit from incorporating fairness. In surveys, such as those in Frazier (1983), Anderson and Weitz (1992) and Kumar et al. (1995), both retailers and manufacturers state that fairness is a significant factor in channel interactions. A recent study by Cui et al. (2004) shows the promise of incorporating fairness into channel research. In their study, fairness is modeled as self-centered inequity aversion, following Fehr and Schmidt (1999): channel members are willing to give up some material payoff to move in the direction of more equitable outcomes. They show that when channel members care about fairness, they do not need to enter into an elaborate nonlinear pricing contract to coordinate a channel. A constant wholesale price will do, if it is properly set. In other words, the problem of double marginalization can disappear when fairness is an accepted norm in channel interactions.

As a final comment on fairness, a general theme in the experimental literature (in common with the literatures on reference dependence and confirmatory bias) is the importance of context. Depending on context, perceptions of fairness may be shaped by the status quo, culture, order effects, decision framing, focal points, allocative equity, and procedural justice. We look forward to richer theoretical models that explore the implications of fairness associated with different contextual determinants.

### *Confirmatory Bias*

In many decision-making situations, decision makers begin with a set of beliefs and subsequently gather additional information to update their prior beliefs before making decisions. Confirmatory bias is the tendency of decision makers to favor their prior beliefs (or working hypotheses) much more than normative models would dictate. Most of the traditional models in marketing, statistics and economics model the decision makers as engaging in optimal data collection and employing Bayes' Rule to update the prior beliefs in the light of new data. For example, in models of search (e.g. Weitzman, 1979), consumers use Bayes' rule to revise their priors about other stores' prices after finding the price at a store, and then decide whether to search further.

However, a large literature in psychology has accumulated a substantial body of evidence that decision-makers tend to overweigh their prior beliefs or existing hypotheses. In an extensive review of this literature, Klayman (1995) suggests that confirmatory biases can arise in one of the following ways:

1. Individuals may be overconfident in their initial belief.
2. Individuals may look for additional data that favors their initial beliefs and ignore additional data that does not support their initial beliefs.
3. Individuals may interpret the additional data in ways that favor the initial belief.
4. Individuals may hold to an old belief because they have difficulty generating new hypothesis even when they want to abandon the old belief.

There is also evidence for similar effects such as escalation bias (Staw and Ross, 1987), status-quo bias (Samuelson and Zeckhauser, 1988) and predecisional distortion (Russo et al. 1998). Given this large body of evidence, it is not surprising that researchers have begun to incorporate confirmatory bias effects into their theoretical and empirical models. Boulding et al. (1999) and Biyalogorsky et al. (2004), start with the assumption that decision makers (consumers or managers) hold uncertain prior beliefs about an object that can be represented by a normal distribution with a given mean and variance. The decision maker updates these beliefs by integrating in new information, but the updating process deviates from standard Bayesian updating in the following ways:

1. The decision maker's perception of a new piece of information is colored by the individual's prior belief. Thus, if the person has a positive (negative) prior belief, as measured by the mean of this prior, the person is more likely to perceive the new piece of information to be more positive (negative) than some objective observer. Furthermore, this bias increases as the person's uncertainty increases.
2. A person's weighting scheme is influenced by the person's perception of the new information. If the person perceives the new information as "confirming" her prior belief, then that person gives more weight to this piece of information. If the new information does not confirm her prior, the individual gives this piece of information less weight. In this way the person "constructs" his/her utility function on the fly.

In addition to these studies, many interesting avenues exist for incorporating confirmatory bias into marketing models. One area where confirmatory bias arises is in frequently purchased goods markets. In these markets, consumers repeatedly face the same purchase decisions and can combine their past experiences with new information. They also have the ability to gather more information by engaging in information search or by experimenting. Therefore, confirmatory bias can manifest in the decision making process for frequently purchased goods in one or more of the five ways described above. Both theoretical and empirical models of consumer choice can benefit from incorporating some of these effects.

Confirmatory bias issues are also important in product categories where purchases are less frequent but consumers encounter information sequentially, for example, in gathering

information about attributes of different products or prices at different stores in buying a high-definition television or a washing machine. Consumers also encounter new information through new product introductions and commercial messages from new entrants. One can expect consumers to have a set of beliefs about incumbents and their existing products. Consumers are more likely to engage in confirmatory testing of strongly held beliefs rather than weakly held beliefs. Therefore, new insights on the new entrant's positioning as well as advertising strategies could be obtained by incorporating confirmatory biases in analysis of consumers' evaluations of new products. In addition, analyzing incumbent and entrant strategies based on such analysis is a fruitful avenue. For example, Kalra et al. (1998) examine the timing and magnitude of incumbents' reactions to a new entry and show that incumbents may delay their reactions to this new entrant. Such a practice may help keep the customers' knowledge of the true quality level of the new entrant diffused. Moorthy (1988) analyzes the product quality choices for the first and second entrants in a vertical differentiation model and shows that the first mover would choose a higher quality than the second mover. Incorporating confirmatory bias in such frameworks could be interesting.

### Summary

Models of consumers and firms derived from microeconomic theory have served us well. They have provided insight into marketing phenomena, and useful predictions. In addition, they have helped us set a baseline for the equilibrium behaviors and strategies players engage in when they behave as rational individuals. On the other hand, behavioral researchers have documented anomalies that point to systematic deviations from utility-maximizing behavior. So, the natural question to ask is: If these anomalies are systematic and robust, how would incorporating these in analytical models change our view of equilibrium behaviors and strategies? In this paper we identified three interesting anomalies and discussed their importance and relevance for marketing.

We suggest that future research evolve in at least three complementary directions:

1. Experimental and empirical researchers should continue to establish the importance and robustness of behavioral anomalies in realistic marketing settings.
2. Attempts should be made to explain anomalies under utility-maximizing frameworks, taking into account the rational inferences subjects might make in experimental settings.
3. Modelers should incorporate behavioral anomalies into their theoretical models to determine what implications they have for firm strategies.

### Notes

1. The extensions by Kopalle et al. (1996) suggest that this result may not always hold.
2. A similar problem may occur if the utility function is increasing in the reference price:  $dU(p,r)/dr > 0$  for all  $r$ .
3. If the participation constraint of consumers is explicitly modeled, then demand may not be infinite. Rather, each consumer may pay their reservation price.

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