A Rational Reconstruction of the Compromise Effect: Using Market Data to Infer Utilities

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This article explores the possibility that consumers use market data to make inferences about product utilities. The argument is made by means of an example based on the "compromise effect" found in extant experimental data. This phenomenon is generally looked at as a manifestation of deviations from rationality in choice. However, assuming full rationality, I describe a decision rule that is based on consumers' inferences about their personal valuation of alternatives from the portfolio of market offerings and some information about their own relative tastes. Through a number of examples, I will argue that consumers often use this or similar decision rules to make inferences about utility. I then show that the decision rule may generate compromise effects in experiments and that it may be sustainable. The compromise effect could therefore be seen as preliminary evidence that consumers make such inferences.

The literature in behavioral decision theory has identified a large number of choice patterns that deviate from those predicted by the standard model of rational choice. An important class of these deviations involves situations where the choice between two alternatives depends on the presence of other, less attractive, alternatives. One such anomaly that has recently received much attention is Simonson's (1989) experimental observations of "compromise effects." The essence of the effect can be described as follows: Suppose that there is a natural ordering (e.g., in terms of price) of three alternatives. Choices from pairs of these alternatives may be inconsistent with choices from all three. Specifically, when three alternatives are presented, the middle alternative is chosen more often than when it is paired with only one other alternative. These effects may be strong enough to violate "regularity"; that is, the "market share" of an alternative may be increased by an additional option. In many models of decision making, for example, in random utility models, violations of regularity are inconsistent with rational choice (Tversky and Simonson 1993), and the general belief in the literature seems to be that violations of regularity always indicate violations of rationality. However, in the present article I will show that the compromise effect is consistent with rational consumers' making inferences about utilities from market offerings. After an intuitive introduction, I will make the formal argument in three steps. First, I will describe a specific inference-based choice rule, the rank-order decision rule, and argue that it often describes consumer behavior. Second, I show that the rank-order decision rule may generate compromise effects, and third, I show that it may be sustainable, in the sense that it continues to be rational even if firms optimize against it.

THE INTUITIVE ARGUMENT

The intuition behind the rank-order decision rule and its link to the compromise effect can be brought out by a few examples. Start by imagining yourself as a beginning musician (e.g., a violinist). You have no idea about the price-quality trade-off in the market, but you believe that some violin must be worth buying. In this case, you would probably buy one of the cheapest violins available, and one could interpret this as being based on the presumption that quality is worth less to you than to more experienced players. Suppose next that you want to buy a table for your children's basement shop. In this case you will probably buy a table of strong

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construction but be unwilling to pay a lot for enhanced appearance, which is consistent with presumptions about the nature of your needs relative to others' needs. The idea in these examples is that decision makers who do not know their absolute but only their relative tastes can infer (or try to infer) the correct choice from market offerings, based on the assumption that these reflect the distribution of needs in the population. This results in a decision rule that suggests that consumers should choose from a perhaps multidimensionally ordered set of products based on their positions in a corresponding order of tastes. I will call this the rank-order decision rule, because it prescribes that consumers buy the brand that consumers with their taste rank would buy if the choice set reflected the distribution of tastes in the population.

To see how the rank-order decision rule can produce compromise effects, I offer an example suggested by a referee. Say that you know that you are an "average American" when it comes to wines. In a specific store you see that prices range from $4 to $30 and that a prominent display has a $14 bottle and a $20 bottle. You would probably still be uncertain about the price point that in this store corresponds to average preference. Thus, if you know that your tasting ability is too poor to appreciate anything above average, you might choose the $14 bottle. On the other hand, if a third bottle priced at $26 is added to the display, you learn more about prices and assortment, and the $20 bottle looks more middle of the road. So in an experimental setting you and your alter ego could well select the $14 bottle from the ($14, $20) choice set and the $20 bottle from the ($14, $20, $26) choice set, thus displaying a compromise effect.

In the remainder of the article I will make this intuition more precise.

THE RANK-ORDER DECISION RULE

Let me start by stating exactly the conditions under which the consumer can use the rank-order decision rule perfectly. Tastes are distributed over known dimensions, and the consumer knows the quantiles in which his tastes fall. Some part of the taste density may be known exactly, but in an area around the consumer's quantile, he only knows that the distribution comes from a certain family of distributions. For example, he may know the shape of the distribution but not its exact location. The consumer now imagines a world in which all consumers know their absolute tastes and all firms make rational product-design decisions given the taste distribution. For a given taste distribution, such a world would have an ordered set of, say, K products, and our consumer would buy the product with rank k. Suppose that in the imagined world our consumer would buy the kth product for all the possible taste distributions. In this case the rank-order decision rule prescribes that he buy the kth product also in the actual market.

One can describe the workings of the decision rule as follows. Consider a choice from a set of alternatives in an attribute space. It is clearly possible to place decision makers in the same space such that the alternative closest to them is their best choice (Coombs 1964). Therefore, if we inform decision makers of the locations of the alternatives and themselves, they can choose on the basis of closeness rather than absolute valuations of locations (i.e., attribute levels). Consider the violin example: There are two attributes (quality and price), but for an appropriate deformation of quality, undominated alternatives should be ranked on a one-dimensional (quality/price) scale. As a beginner you know your own relative valuation of quality and can thus place yourself (your ideal point) on a quantile of the distribution of ideal points on the quality/price scale. On the assumption that the set of market offerings bears a specific relationship to the distribution, you can map your own relative quality sensitivity onto the product space. The same thing works in higher dimensions, as in the table example. Alternatives and relative needs are rated on two attributes (strength and appearance), and you assume that the available alternatives reflect the distribution of the needs of buyers.

In the appendix, I will show how rational product-design decisions by firms result in a set of market offerings that are such that the assumed fit between market offerings and the distribution of consumer needs actually will materialize. For now, we will just assume that the consumers have quite specific beliefs about how different sets of market offerings reflect different distributions of tastes. Given these beliefs, the set of market offerings, combined with information about relative tastes, allows consumers to make the same choices as does information about their absolute tastes. The question is then, When is information more conveniently available in terms of absolute tastes or relative tastes? The relevant factors are easy to identify. First, when the importance of product attributes is very difficult to evaluate, it is more attractive to use relative tastes (see, e.g., Ratneshwar, Shocker, and Stewart 1987). Second, relative tastes can be assessed more precisely if they can be assumed to correlate well with subjectively well-known measures, such as relative body size, preference for quality, risk aversion, and the like.

It is worth noting that one can significantly weaken the informational assumptions without losing the flavor of the theory. Specifically, many consumers can identify their best choice with much less information. If only two alternatives exist and I know that my taste places me in, say, the top 50 percent, I should probably choose the top-ranked alternative. Similarly, although with coarser information, the decision rule may not always identify the best choice, yet it may still perform fairly well on the average. Strong assumptions are only needed to show that all users can use the rule to eliminate all mistakes.

Let me now explicitly show how the rank-order decision rule can produce compromise effects in experiments.

COMPROMISE EFFECTS

To introduce the argument, I start with a very simple case in which a market has three consumer segments, I, II, and III. There are s_{I} percent of all consumers in segment I, s_{II} percent in II, and 100 percent $- s_{\text{I}}$ percent $- s_{\text{II}}$ percent $= s_{\text{III}}$ percent in III. The segments differ in quality sensitivity such that consumers in III will pay more for quality than consumers in II, who again will pay more than consumers in I. There are three brands in the market, which we will label 1, 2, and 3 in order of increasing price and quality. Consumers in segment I prefer brand 1 over brand 2, and brand 2 over brand 3. Consumers in segment III prefer brand 3 over brand 2, and brand 2 over brand 1. Consumers in segment II prefer brand 2 over brand 1, and brand 1 over brand 3. If we use $U_i(j)$ to denote the utility to a consumer in segment $i \in \{\text{I, II, III}\}$ of brand $j \in \{1, 2, 3\}$, we may formally state our taste assumptions as

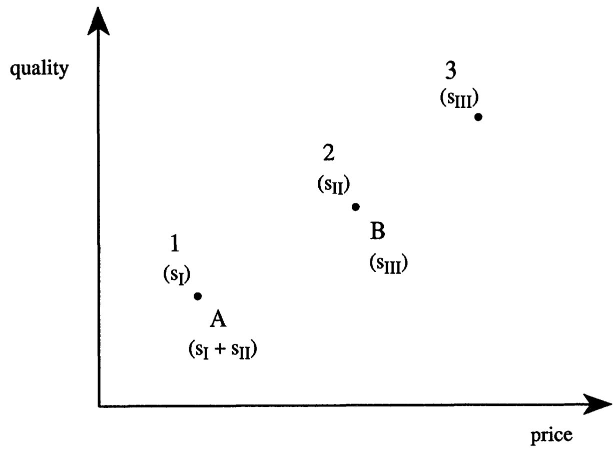
$$U_{\text{I}}(1) > U_{\text{I}}(2) > U_{\text{I}}(3),$$
$$U_{\text{II}}(2) > U_{\text{II}}(1) > U_{\text{II}}(3),$$
$$U_{\text{III}}(3) > U_{\text{III}}(2) > U_{\text{III}}(1).$$

Consider now an experiment in which consumers know which segment they belong to (i.e., they know their relative taste). Consumers also know that there are three brands in the market, and they can order any two brands in terms of relative quality and price. This means that if consumers are presented with all three brands, then they can identify them, and because they know the preference rankings shown above, they can select that which is best for their segment. However, we assume that consumers cannot evaluate the *absolute* utilities of any brands. So they cannot compare the utilities from a lower-quality, lower-price brand and a higher-quality, higher-price brand. This means that if consumers are presented with two brands, a lower-quality, lower-price brand A and a higher-quality, higher-price brand B, then they will know that A is of lower quality and price than B, but they will not know whether (A, B) is $(1, 2)$, $(2, 3)$, or $(1, 3)$. In such a case we will start by assuming that consumers put probability of one-third on each of the three possibilities.

Suppose now that a representative set of consumers are offered a choice between brand 1 and brand 2, and that they do not know the identities of the brands. In this case a consumer in segment II will select the brand (A) with lowest quality and price because his or her expected utility from that choice is ⅓[utility if $(A, B) = (1, 2)$] + ⅓[utility if $(A, B) = (2, 3)$] + ⅓[utility if $(A, B) = (1, 3)$], or

FIGURE 1

CHOICE FROM FULL AND RESTRICTED SETS



Note.—Market shares are in parentheses.

$$EU_{\text{II}}(A) = \frac{1}{3}\,U_{\text{II}}(1) + \frac{1}{3}\,U_{\text{II}}(2) + \frac{1}{3}\,U_{\text{II}}(1) = \frac{2}{3}\,U_{\text{II}}(1) + \frac{1}{3}\,U_{\text{II}}(2), \quad (1)$$

whereas

$$EU_{\text{II}}(B) = \frac{1}{3}\,U_{\text{II}}(2) + \frac{2}{3}\,U_{\text{II}}(3). \quad (2)$$

So A will be chosen because $U_{\text{II}}(1) > U_{\text{II}}(3)$. By analogous reasoning a consumer in segment I will choose A, while a consumer in segment III will choose B. So in this case option A (i.e., 1) will get s_{I} percent + s_{II} percent of the "market," while option B (i.e., 2) gets s_{III} percent. If another set of consumers are given a choice among all three products, the s_{III} percent who used to prefer B (i.e., 2) will now prefer 3. More important, the s_{II} percent of consumers who chose 1 (A) over 2 (B) in the set $\{1, 2\}$ will choose 2 in the set $\{1, 2, 3\}$. This is illustrated in Figure 1. This example shows that the emergence of a third alternative can reverse the choice between two alternatives. If the middle segment is larger such that $s_{\text{II}} > s_{\text{III}}$, the share of option 2 in $\{1, 2, 3\}$ is bigger than the share of B (i.e., 2) in $\{A, B\}$. So in this example the emergence of a third alternative causes the market share of an alternative to increase, which violates a type of regularity.

The above example assumes that subjects had a flat prior distribution over the feasible actual ranks of each alternative. In Simonson's (1989) experiments, subjects were less agnostic. They had some previous familiarity with the product category, and they were given the attribute-level ranges of market offerings. To model this, we make some minor modifications in the example. We assume that there are five segments. Two are served by the products at the extremes of the attribute scale, and three (1, 2, 3) are between those extremes. We focus on the case where the absolute tastes of the extreme segments are known, and all uncertainty concerns the absolute tastes of the three middle segments. As an example, the three middle segments may all be close to the lower extreme, may all be close to the higher extreme, or may be more evenly spread. We consider a consumer in segment II who is faced with two nonextreme alternatives, A and B. Based on A and B, as well as prior knowledge, the consumer's prior probability of the choice set being (i, j) is $p_{i,j}$, such that $p_{1,2} + p_{2,3} + p_{1,3} = 1$. Given this, the expected utility of choosing A is

$$EU_{II}(A) = (p_{1,2} + 1 - p_{2,3} - p_{1,2})U_{II}(1) + p_{2,3}U_{II}(2) = (1 - p_{2,3})U_{II}(1) + p_{2,3}U_{II}(2). \quad (3)$$

Similarly,

$$EU_{II}(B) = p_{1,2}U_{II}(2) + (1 - p_{1,2})U_{II}(3), \quad (4)$$

and A will be chosen if and only if

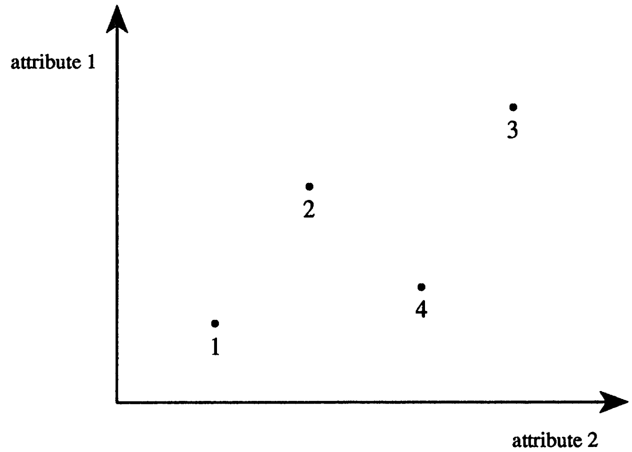
$$U_{II}(1) > \frac{p_{1,2} - p_{2,3}}{1 - p_{2,3}} U_{II}(2) + \frac{1 - p_{1,2}}{1 - p_{2,3}} U_{II}(3). \quad (5)$$

So if $(A, B) = (1, 2)$ and Equation 5 holds, consumers in segment II will choose A (i.e., 1) from (1, 2), but they will choose 2 from (1, 2, 3). If the prior beliefs reflect good information, then $p_{1,2} > 1/3$, and Equation 5 is stronger than $U_{II}(1) > U_{II}(3)$, but the effect can exist as long as some uncertainty remains, that is, as long as $p_{1,2} < 1$.[1]

In a two-dimensional example, suppose that the identically priced alternatives 1, 2, 3, and 4 are located in two-dimensional attribute space, such that 3 dominates all, 1 is dominated by all, and 2 and 4 cannot be ranked by dominance. (Keep in mind that we are working with an ideal-point model. Dominance refers to attribute levels, not preference.) This is illustrated in Figure 2.

FIGURE 2

EXAMPLE IN TWO DIMENSIONS



If a consumer is presented with a two-alternative choice set where A dominates B, the pair (A, B) must belong to the set {(3, 1), (3, 2), (3, 4), (2, 1), (4, 1)}. Suppose that the consumer values 2 positively, while s/he values the other alternatives at zero. With flat prior distributions, if the consumer wants to maximize the chance of getting 2, s/he is indifferent to the choice between A and B. On the other hand, if a third alternative, C, is presented such that B dominates C, the triple (A, B, C) must be either (3, 2, 1) or (3, 4, 1), and the consumer will select B.

More generally, suppose that K alternatives are located in an n-dimensional attribute space. For simplicity, we assume that no two alternatives tie (i.e., are exactly equal) on any attribute. In this case a pair of alternatives can be ordered in 2^n different ways that correspond to dominance on each attribute (3^n if we allow ties). There are $\frac{1}{2}K(K - 1)$ possible pairs of alternatives, and if $\frac{1}{2}K(K - 1) > 2^n$, there always exists a two-element choice set whose dominance profile fails to reveal the identity of the members. Such a set, combined with prior distributions, induces two nondegenerate probability distributions defined over the K alternatives. Consider now a segment, j, for which the best choice could be A or B, both with strictly positive probability. Any choice of j may be "wrong" relative to full information, and by expanding the choice set sufficiently (say, to K members) this will be revealed. So for any K locations in n-space, if $\frac{1}{2}K(K - 1) > 2^n$, there always exist a two-element choice set and a segment such that a larger choice set induces reversals.

In sum, if consumers are given first a smaller and then a larger choice set, the rank-order decision rule may lead to violations of regularity as long as consumers are uncertain about the (population) ranks of the initial choice set. If the rank-order decision rule may be rational in these cases, this shows that rationality and violations of regularity may be consistent. To demonstrate the sustainability of the rank-order decision rule, we need to show that it maximizes utility, even if firms know it is used and try to maximize against it. Because this demonstration is rather technical and perhaps less controversial, it is relegated to the appendix.

DISCUSSION

I have described a decision rule in which consumers leverage market information to infer product utilities. I argued that the decision rule is plausible and characterized cases in which it must be expected to perform well. I next demonstrated that Simonson's (1989) ex-

[1] I am indebted to a referee for this argument.

perimental findings of compromise effects may be compatible with the rank-order decision rule. Because the appendix demonstrates that this decision rule may be sustainable, I have shown that compromise effects may be robustly compatible with rationality. In particular, I have shown that the emergence of a third alternative may reverse the choice between two alternatives and cause the share of an alternative to increase. More generally, this shows that the compromise effect could be seen as a manifestation of consumers' using market offerings to infer utilities.

There are, of course, a number of alternative explanations for the compromise effect. An intriguing, and to some extent complementary, argument is provided by Parducci's (1974) range-frequency theory of perception. According to this theory, the perceived distance between two ordered objects decreases if a third, more extreme object is introduced. (Similarly, the perceived distance increases if an intermediate object is introduced.) This could explain the compromise effect in the following example: Suppose that the consumer, based on relative tastes, wants to buy a brand that scores "low, but not too low" on some attribute. If we compare the choice sets $\{A, B\}$ and $\{1, 2, 3\}$ in Figure 1, it is possible that B is perceived as "too high," while 2 is perceived as "just right." In this nesting, the behavior producing the compromise effect is not rational in the sense that it relies on estimation of the market rank of different alternatives. Rather, the effect is the result of systematic perceptual bias. Because the range-frequency theory has been subjected to tests outside the domain of product choice, there is no question that this perceptual bias exists. In the context of product choice, careful experimental work is required to discriminate between rational inference and these perceptual biases.

Just as the compromise effect may be explained in several different ways, the hypothesis of market inference may explain a number of other phenomena. A general treatment of market inference is rather difficult because several kinds of information (e.g., rank, attribute levels, market share, price) can be used by consumers to inform them about several things (e.g., fit, attribute importance, quality). However, another important anomaly, which I will discuss briefly, is the attraction effect (Huber and Puto 1983; Pan and Lehmann 1993). The essence of the attraction effect is that the market share of an alternative may increase if a similar (but dominated) alternative is introduced. One could explain this effect in a model in which the consumer applies the rank-order decision rule at the attribute level. Instead of inferring absolute product utilities, s/he infers attribute weights from market offerings. The consumer may be unsure of the proper weight of an attribute but may know his or her tastes for it relative to those of the other consumer. Suppose that the consumer knows that 75 percent of all consumers weight the attribute less than s/he does. If most observed alternatives score high on the attribute, the consumer may infer that it should be weighted heavily. As described, this is a rational decision rule, which is consistent with the behavioral utility functions proposed by several authors. Specifically, it could be seen as a rationalization of the contingent weighting schemes of Tversky, Sattath, and Slovic (1988) and the trade-off contrast model of Tversky and Simonson (1993). It should be noted however, that the attraction effect also has several alternative explanations. In particular, it is consistent with Parducci's (1974) range-frequency model as well as the "attention" mechanism discussed by Huber, Payne, and Puto (1982).

Concerning the present model of the compromise effect, a number of comments are in order. First, I do not wish to claim that the mechanism highlighted here explains all instances of compromise effects, only that it explains some part of the phenomenon in some cases. Second, the model was designed to explain compromise effects, not to explain all existing findings of context effects. For any given context effect it is possible that a rational reconstruction can be given, but to keep the analysis manageable each effect would require a separate model. So the fact that the model may be unable to explain other types of context effects does not bother me. Third, it is interesting to note that Simonson (1989) found that the compromise effect was stronger in more complex choices. The present model suggests that the effect will be stronger when it is harder to access the absolute importance of individual attributes. The present model is also consistent with some of Simonson's other findings and interpretations. Simonson (1992) writes, "Purchase decisions are determined on the basis of both absolute attributes of the alternatives and their relative positions within the particular choice set under consideration" (p. 6). He further suggests that "consumers are less likely to choose alternatives that were selected by other consumers for reasons that do not apply to them" and that "consumers are less likely to choose alternatives that are offered with unneeded features or premiums, even when these features do not reduce the value of the product in any way" (p. 13). These interpretations and findings are consistent with the spirit of the present theory. Finally, and most important, I recognize that the logical possibility (and perhaps even the plausibility) that consumers use the rank-order decision rule does not demonstrate that they actually use this rule. Only experimental evidence can demonstrate actual use. We are in the process of collecting data to explore this.

APPENDIX

Sustainability of the Rank-Order Decision Rule

Because the sustainability of the rank-order decision rule may be intuitively obvious to some readers and because the following is a bit technical, it is relegated to this appendix. To keep the exposition as simple as possible, I work with an even simpler example than that used in the body of the article and confine my attention to pure strategy equilibria. Within this model, I first show that Equations A5–A8 below characterize the full-information equilibrium. This allows me to describe the rank-order decision rule. Second, I assume that some consumers follow this rule and that sellers know about it. In the context of an example, I demonstrate that the users of the rank-order decision rule still make the "right" choices. Because this conclusion is reached in an example, I go on to a more general case, and it turns out that some distortions may exist but vanish as firms use longer time horizons.

1. Two firms, 1 and 2, play a two-stage (quality first, price second) game, and the cost of producing x units of quality, q, is xq^2. I label the firms such that $q_1 < q_2$. Consumer i's utility function is $U_i = (b + r_i)q - p$, where r_i measures the relative valuation of quality, while $b + r_i$ is the absolute valuation. There is a unit mass of consumers, each of whom knows his or her own r_i and each of whom observes the (price, quality) offerings (p_1, q_1), (p_2, q_2). A fraction, $\alpha > 0$, of the consumers are informed and know b, while the other, uninformed, consumers use the rank-order decision rule and buy the product with the rank they would buy if there were perfect information in the market. For both groups of consumers, the r_i's are uniformly distributed on [0, 1].

To get a benchmark for the rank-order decision rule, we start with the full-information case and note that the market share of firm 1 is given by the higher of 0 and $\| \{ i \mid (b + r_i)q_1 - p_1 > (b + r_i)q_2 - p_2 \} \|$. If this is positive, it equals $(p_2 - p_1)(q_2 - q_1)^{-1} - b$, and profits are

$$\Pi_1 = [(p_2 - p_1)(q_2 - q_1)^{-1} - b](p_1 - q_1^2), \quad \textbf{(A1)}$$

$$\Pi_2 = [1 + b - (p_2 - p_1)(q_2 - q_1)^{-1}](p_2 - q_2^2). \quad \textbf{(A2)}$$

Analyzing the pricing stage first, we get

$$p_1^*(q_1, q_2) = \frac{[(1 - b)(q_2 - q_1) + 2q_1^2 + q_2^2]}{3}, \quad \textbf{(A3)}$$

$$p_2^*(q_1, q_2) = \frac{[(2 + b)(q_2 - q_1) + q_1^2 + 2q_2^2]}{3}. \quad \textbf{(A4)}$$

We subtract p_1^* from p_2^*, insert into Π_1 and Π_2, differentiate with respect to the firm's own quality, and get

$$q_1^* = \frac{(4b - 1)}{8}, \quad \textbf{(A5)}$$

$$q_2^* = \frac{(4b + 5)}{8}. \quad \textbf{(A6)}$$

So

$$p_1^* = \frac{(25 - 8b + 16b^2)}{64}, \quad \textbf{(A7)}$$

$$p_2^* = \frac{(49 + 40b + 16b^2)}{64}, \quad \textbf{(A8)}$$

and we have shown

CLAIM 1. If $\alpha = 1$, then Equations A5–A8 describe an equilibrium.

In this equilibrium, each firm gets one-half of the market, and the rank-order decision rule therefore suggests that a consumer for whom $r_i \in [0, 1/2]$ buy product 1, while if $r_i \in [1/2, 1]$, s/he should buy product 2.

2. Suppose now that $\alpha < 1$, such that $1 - \alpha$ consumers follow the rank-order decision rule while α consumers buy product 1 if and only if $(b + r_i)(q_2 - q_1) < p_2 - p_1$. So the profits are

$$\Pi_1 = [\alpha(p_2 - p_1)(q_2 - q_1)^{-1} - \alpha b + (1 - \alpha)1/2] \times (p_1 - q_1^2), \quad \textbf{(A9)}$$

$$\Pi_2 = [\alpha + \alpha b - \alpha(p_2 - p_1)(q_1 - q_2)^{-1} + (1 - \alpha)1/2](p_2 - q_2^2). \quad \textbf{(A10)}$$

In this case we proceed as in section 1 to find that the equilibrium is

$$p_1^0(q_1, q_2) = \frac{1}{3}\left[(1 - b)(q_2 - q_1) + 2q_1^2 + q_2^2 + \frac{3}{2}\frac{1 - \alpha}{\alpha}(q_2 - q_1)\right], \quad \textbf{(A11)}$$

$$p_2^0(q_1, q_2) = \frac{1}{3}\left[(2 + b)(q_2 - q_1) + q_1^2 + 2q_2^2 + \frac{3}{2}\frac{1 - \alpha}{\alpha}(q_2 - q_1)\right], \quad \textbf{(A12)}$$

$$q_1^0 = \frac{\left(4b - 1 - 3\frac{1 - \alpha}{\alpha}\right)}{8}, \quad \textbf{(A13)}$$

$$q_2^0 = \frac{\left(4b + 5 + 3\frac{1 - \alpha}{\alpha}\right)}{8}. \quad \textbf{(A14)}$$

To evaluate the sustainability of the rank-order decision rule, we look at a consumer for which $r = 1/2$. The utility of product 1 is $(b + 1/2)q_1^0 - p_1^0$, and that of product 2 is $(b + 1/2)q_2^0 - p_2^0$. Substitution of Equations A11–A14 reveals that these utilities are identical and that product 1 is better if and only if $r < 1/2$. So we have shown

CLAIM 2. For this model, the rank-order decision rule is sustainable for any $\alpha > 0$.

While this may seem like magic, it is a knife-edge result that depends critically on the utility function used in the model. For other utility functions, the value of r for which $U_1 = U_2$ deviates from one-half according to a function of α. It is possible to find other sets of assumptions under which the rank-order decision rule is sustainable in a static model. However, one cannot avoid the knife-edge property in static models.

3. To make the rank-order decision rule asymptotically sustainable in the general case, we have to resort to a dynamic version of the model. Specifically, we assume that quality is set once and for all, while prices can be changed each period. After the first period, all consumers know b, so prices will stay the same from the second period onward. Together, these assumptions have the effect that quality distortions only benefit the firm as long as information is poor (the first period) but hurt it thereafter. We use Π^α to denote the first-period profit functions and Π^1 for the later periods. We assume only that these functions admit of unique pure strategy equilibria.

Assuming that both firms use the discount factor δ, we look at an infinite horizon game where p denotes first-period prices and P are prices in later periods. With this notation, firms 1 and 2 maximize the net present value, V_1 and V_2, of profits:

$$V_1 = \Pi_1^\alpha(p_1, p_2, q_1, q_2) + \frac{\delta^2}{1-\delta}\Pi_1^1(P_1, P_2, q_1, q_2), \quad \textbf{(A15)}$$

$$V_2 = \Pi_2^\alpha(p_1, p_2, q_1, q_2) + \frac{\delta^2}{1-\delta}\Pi_2^1(P_1, P_2, q_1, q_2). \quad \textbf{(A16)}$$

As $\delta \rightarrow 1$, the relative weights favor the "long-term" components of Equations A15 and A16, and the equilibrium approximates the full-information outcome (p^*, q^*). So, as long as some consumers start out as informed, first-period prices and qualities will approximate full-information prices and qualities arbitrarily closely as the firms get very patient. Formally, if the equilibrium of the infinite horizon game is (p^∞, P^∞, q^∞), we have

CLAIM 3. $\forall\ \epsilon, \alpha > 0\ \exists \underline{\delta} < 1\ \forall\ \delta > \underline{\delta}$: $\max\ \{|p_1^\infty - p_1^*|, |p_2^\infty - p_2^*|, |q_1^\infty - q_1^*|, |q_2^\infty - q_2^*|\} < \epsilon$.

Because $U_i(p_1^*, q_1^*) > U_i(p_2^*, q_2^*)$ if and only if $r_i < 1/2$, claim 3 says that the rank-order decision rule is asymptotically rational. Because a high discount factor represents a short purchase cycle, this means that if the purchase cycle is sufficiently short, the outcome is "as if" the consumers were perfectly informed. The rule furthermore performs better when $1 - \alpha$, the fraction of uninformed consumers, is small.

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REFERENCES

Coombs, Clyde H. (1964), *A Theory of Data,* New York: Wiley.

Huber, Joel, John W. Payne, and Christopher Puto (1982), "Adding Asymmetrically Dominated Alternatives: Violations of Regularity and the Similarity Hypothesis," *Journal of Consumer Research,* 9 (June), 90–98.

——— and Christopher Puto (1983), "Market Boundaries and Product Choice: Illustrating Attraction and Substitution Effects," *Journal of Consumer Research,* 10 (June), 31–44.

Pan, Yigang and Donald R. Lehmann (1993), "The Influence of New Brand Entry on Subjective Brand Judgments," *Journal of Consumer Research,* 20 (June), 76–86.

Parducci, Allen (1974), "Contextual Effects: A Range-Frequency Analysis," in *Handbook of Perception,* Vol. 2, ed. Edward C. Carterette and Morton P. Friedman, New York: Academic Press, 127–141.

Ratneshwar, Srinivasan, Allan D. Shocker, and David W. Stewart (1987), "Toward Understanding the Attraction Effect: The Implications of Product Stimulus Meaningfulness and Familiarity," *Journal of Consumer Research,* 13 (March), 520–533.

Simonson, Itamar (1989), "Choice Based on Reasons: The Case of Attraction and Compromise Effects," *Journal of Consumer Research,* 16 (September), 158–174.

——— (1992), "Get Closer to Your Customers by Understanding How They Make Choices," working paper, Haas School of Business, University of California, Berkeley, 94720.

Tversky, Amos, Shmuel Sattath, and Paul Slovic (1988), "Contingent Weighting in Judgment and Choice," *Psychological Review,* 95 (3), 371–384.

——— and Itamar Simonson (1993), "Context-Dependent Preferences," *Management Science,* 39 (October), 1179–1189.

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