

CONSUMER RATIONALITY AND ECONOMIC EFFICIENCY: IS THE ASSUMED LINK JUSTIFIED?

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In this paper, the authors investigate a basic assumption underlying most models based on social or mathematical psychology that consumers are rational in the sense of choosing the most economically efficient brand. Using Data Envelopment Analysis (DEA) for measuring the efficiency of individual consumer choice, they report the results of two empirical studies, one involving the social psychology based theory of reasoned action and the other involving the mathematical psychology based traditional conjoint analysis, that were conducted to investigate the economic efficiency underlying the individual choice predictions of the particular model. Results indicate that, in either case, the predictions are not independent of economic efficiency. Further, either model has a significantly higher first choice hit rate for the homo economicus group than for the other group. Implications of these results for market segmentation as well as directions for future research are discussed.

INTRODUCTION

It is common knowledge that the choice process has captured the attention of a diverse group of researchers spanning economics, social psychology, mathematical psychology, and of course, marketing. Although there are virtually countless contexts characterized by the choice process, choice behavior enacted within the consumer-marketplace domain is the most relevant for the practicing marketing manager. By and large, the choice process in general and consumer choice in particular have been well researched. Nevertheless, to our best knowledge, one cardinal assumption has remained untested in the literature, and it has to do with the role of economic efficiency in the consumer choice process. This paper focuses on this aspect.

The theory of efficiency of consumer choice stems from an axiom within the larger assumption of rationality in decision making embedded in both

social psychology and mathematical psychology. This axiom states that consumers are rational in the sense of choosing the most economically efficient brand. The primary purpose of this research is to investigate this basic assumption underlying various models of consumer choice. Toward this end, two separate studies were conducted which are reported here. In both studies, we employed Data Envelopment Analysis (DEA) for measuring the efficiency (or inefficiency) of individual consumer choice. In view of this, before we describe these studies, it is imperative that we first elucidate the concept of efficiency of individual consumer choice and then furnish a brief description of DEA.

EFFICIENCY OF CONSUMER CHOICE

Lancaster (1966; 1971) modified the concept of a good, and consequently the analysis of consumer demand, by suggesting that consumers have demand for attributes of a specific good rather than the good itself. Ladd and Zober (1977) and Hauser and Simmie (1981) have extended the Lancasterian model from characteristics space to consequence maps, thus providing a useful framework for thinking about consumer demand. In this paper, we

adopt a perspective quite similar to that advanced by Fornell, Robinson and Wernerfelt (1985) wherein they liken consumer consumption of products to a production process. This framework views the product purchased by the consumer as an input which gets converted to an output by means of this consumption process. We advance this input-output orientation one step before the consumption of the product to the actual purchase of a product. Therefore, the product purchase itself, together with the consumption, can now be viewed as a process involving both inputs and outputs. For example, the price of a brand or a product could be an input. Another input could be the time spent in searching for a specific brand. Only after the consumer has expended these inputs into the purchase-consumption process can he/she enjoy the associated outputs or the benefits obtained from the brand.

The associated outputs or the product benefits can range from such easily quantifiable aspects as "horse power" and "miles per gallon" to intangibles as "gentle on hands" and "sparkling dishes". The outputs can be considered the dimensions usually used to represent products in traditional multidimensional maps. In such a framework involving inputs and outputs, the concept of efficiency or inefficiency of products is a natural consequence. An efficient brand then is one which is not dominated by another brand on all characteristics or dimensions on which the product category is evaluated by the consumer. This definition, of course, implies that an asymmetrically dominated brand (Huber, Payne and Puto 1982), for instance, is an example of an inefficient brand.

A typical assumption of most economic and strategic models is that all products in the market place are portrayed as efficient. However, the study by Hjorth-Anderson (1984) indicates that at least at the micro level there do exist inefficient variants of a commodity. That is to say, it does not seem reasonable to assume that all of the products evoked by an individual consumer would lie on the efficient frontier. While standard economic theory would dictate that all inefficient brands will be driven out of the market place, this may not happen in the short run. So at least in markets which are in a state of flux, perhaps due to factors such as new products

being introduced or current products undergoing modifications, and so forth, customers may evoke brands which do not lie on the efficient frontier.

From the supply side, consistent with the above observation, Huber, Payne and Puto (1982) have stated that under certain conditions it may be actually to the benefit of the firm to introduce an inefficient brand (i.e., decoy). They argue that due to the salience of an inefficient variant on consumer choice strategies, the decoy may actually prove beneficial by boosting the sales of its more efficient counterpart. So, even if standard economic theory calls for the elimination of inefficient products, sophisticated marketing strategy might actually call for their preservation. Therefore, a consumer will quite likely encounter less than efficient brands in the marketplace.

From the demand side perspective, however, a rational consumer would always like to ensure that he/she is making the "best" possible buy. After all, consumer rationality implies the notion of economic efficiency. In other words, of all the available or evoked brands, he/she will choose that which provides the highest utility per dollar (Hauser and Gaskin 1984). Needless to say, in order to be able to select the economically efficient brand, the rational consumer needs to be aware of the different product offerings (decoys and all) in the marketplace, their performance characteristics on salient attributes as well as their related expenses which may include, among others, the amount of effort required to adapt and assimilate the product to his/her individual needs. As stated earlier, this basic assumption of consumer rationality in the sense of choosing the most economically efficient brand no doubt underlies most consumer models. In this paper, we empirically investigate the validity of this cardinal assumption.

DATA ENVELOPMENT ANALYSIS

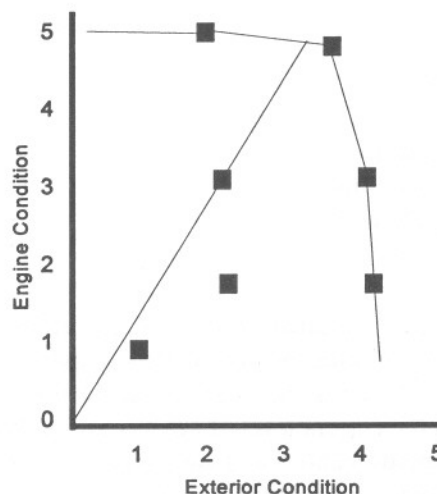
Data Envelopment Analysis (DEA) has become popular since 1978 and interest in its potential for applicability does not seem to have abated. This is evidenced by the spate of articles on DEA that have appeared in a variety of outlets even recently (e.g., Seiford and Zhu 1998; Soteriou and Zenios 1999).

For the context of this research, DEA has been proposed as a technique for implementing the Lancaster model (Charnes et al. 1985). However, most applications of DEA have been in contexts where the notion of a production technology is immediately applicable and the unit of analysis, or the Decision Making Unit (DMU), is generally a firm or some stylized form of production process (Seiford 1990). The analogous DMU in the marketing context would be an aggregation of attributes in the form of a brand or product. Such analyses which use a brand or a product as a DMU are useful in identifying superior products and economically efficient brands.

We present here a simple graphical introduction to DEA. For a more formal mathematical treatment, we refer the reader to Banker et al. (1989). Consider an individual comparing a number of cars on the basis of two criteria, engine condition and exterior condition. Further suppose that these criteria are measured on a five point scale at half point intervals. Then the resulting data for these cars can be represented by the scatter plot in Figure 1. The vehicles rated the best are those which are farthest away from the origin. This set of undominated cars form what is termed to be the *efficient frontier* and all the cars on this frontier are given efficiency scores of unity. Cars which fall between the frontier and the origin are deemed *inefficient* and their efficiency rating is measured in terms of their distance from the efficient frontier. Hence, car models A,B,C and D are deemed efficient with an efficiency rating of 1.0. The efficiency of the cars not on the frontier are measured in distances along the ray from the origin through the point representing the car. For instance, the efficiency of the car at E is the ratio OE/OE'. Note that this ratio is always less than or equal to one.

Extensions to multiple attribute maps follow naturally. One can also develop "per dollar" maps by taking the attribute rating and dividing that by the price the car to obtain a per dollar rating on a given attribute. The per dollar map and the resulting frontier is analogous to the production function from economic theory where the input resource is measured in terms of dollars and the outputs are the attributes of the car. Thus, Figure 1 would represent data shown in the output space. Efficiency scores for multiple attributes and multiple input resources (for

Figure 1
Hypothetical Data on Car Attributes



instance, search effort, cost of other information), can be readily obtained by repeatedly solving, for each car, a mathematical program.

In order to present the linear programming model underlying the measurement of efficiency, we first introduce some notation. Let y_{ij} denote the benefit accruing along the i^{th} dimension (attribute) of the j^{th} brand. Let x_{kj} denote the input required to be expended along the k^{th} dimension of the j^{th} brand in order to obtain the associated benefits. Assuming that there are M brands with N outputs and K input attributes which characterize the product evaluation process, we denote by Y the matrix of output attributes, of order N by M . Similarly, we let X be the matrix of input attributes, of order K by M .

Assume that in attribute-space, these configurations can be represented by combinations of these x and y vectors, then the set of all feasible configurations, such that a proportionality is maintained between x and y is

$$C = \{(x, y) : y \leq Y \cdot z, X \cdot z \leq x, z \in R_+^M\} \quad (1)$$

where, $z = (z_1, z_2, \dots, z_M)$ denotes the vector of parameters which determine the combination of the attributes of the brands. Let (x^0, y^0) be a given observation of attributes of some brand. Then the relative efficiency (RE) of that brand is:

$$RE(x^0, y^0) = \max \{1/\theta: (x^0, \theta y^0) \in C\} \quad (2)$$

which is the optimal solution of the following linear program:

$$\max \quad \theta$$

subject to:

$$zY \geq \theta y^0$$

$$zX \leq x^0$$

$$z \geq 0$$

Thus, in this instance, the relative efficiency measure, $1/\theta$, denotes the proportional expansion in the output attributes that can be achieved while maintaining the current level of inputs (costs). While a variety of modifications and variations of this basic efficiency measure are possible, we restrict ourselves to this simple measure to determine how it fares in investigating individual choice.

It is vital to mention that our point of departure from the standard Lancasterian approach is that the mapping of products is not done in the characteristics space. Instead the products are mapped, as in Hauser and Gaskin (1984) and Hauser and Simmie (1981), in the perceptual space. The reasons are that consumers rarely have the objective information on the various characteristics of products and in many instances, such objective performance measures are hard to quantify. Instead, in keeping with the current marketing focus, we measure the consumers' utility in terms of the satisfaction accruing to them for the various attribute levels. This is more consistent and in line with the marketing concept of maximizing customer satisfaction. This approach also has the added desirability of allowing for heterogeneity in consumer perceptions. That is, different levels of an attribute would provide differing perceived levels of satisfaction to different customers.

Consequently, employing the above linear program, we are now able to scale the product space in terms of utility of satisfaction with the various characteristics on a per input basis. Unlike traditional approaches (Hauser and Shugan 1983), however, we estimate a satisfaction per dollar map at the individual level as we do not assume homogeneity in perceptions. Nor does this approach

require the assumption that all alternative brands in the market place are efficient. This therefore enables us to determine the fraction of individual consumers who make economically efficient choices from a given set of alternatives.

STUDY 1: EFFICIENCY OF CONSUMER CHOICE IN SOCIAL PSYCHOLOGY

To our best knowledge, no one has yet investigated the choice predictions of social psychology based formulations in terms of the efficiency of individual consumer choice. In this section, we report the results of an empirical investigation in the context of efficiency of individual consumer choice employing a widely used attitude formulation, the theory of reasoned action (Ajzen and Fishbein 1980). The theory of reasoned action (TRA) is possibly the most well known among the attitude formulations in social psychology, and hence it was chosen as the predictive model in this study. It has been well documented many times in the literature, and one may refer to the work of Ajzen and Fishbein (1980) for a comprehensive review of TRA. A brief description of TRA is provided here.

The Theory of Reasoned Action

TRA views intention as the immediate antecedent of behavior. Intention is determined by an attitudinal (personal) component and a normative (social) component. The model can be symbolically stated as

$$B \sim BI = w_1(A_B) + w_2(SN) \quad \text{where,}$$

B is overt behavior, BI is behavioral intention (subjective probability of intending to perform behavior B), A_B is attitude toward performing behavior B (e.g., attitude toward buying a brand), SN is subjective norm (normative influence; the collective perceived influence of "important others"), and w_1 and w_2 are empirically determined weights denoting the relative influence of the two components. A_B is determined as $\sum b_i e_i$ ($i=1, \dots, n$) where, b_i is the subjective probability that performing the behavior will result in outcome I , e_i is the individual's evaluation of outcome I , and n is the

number of salient outcomes. SN is determined as $\sum_{j=1}^N NB_j MC_j$ where, NB_j is the belief that referent j thinks the individual should/should not perform the behavior, MC_j is the individual's motivation to comply with referent j , and N is the number of salient referents.

It is pointed out that the extent of agreement between BI and B depends upon the degree of measurement correspondence on the elements of *action* (refers to the behavior of interest), *target* (the object/issue/person figuring in the behavior of interest), *context* (the context in which the behavior of interest is enacted), and *time* (i.e., the time at which the behavior of interest occurs). The hypothesis underlying the application of TRA to a consumer choice situation is that a consumer has a certain level of BI (the predictor of behavior) for each of the available alternatives, and would end up selecting that alternative for which he/she has the highest level of BI.

TRA is a person based, compensatory and compositional technique, and relies on direct input from the consumer. Further, it has a normative (influence of important others) construct through the subjective norm construct. Although it assumes human rationality to prevail in decision making, constraints are not endogenous to the model. However, it implicitly assumes that the individual takes contextual constraints into consideration while responding to measurement items. For more details on these characteristics, see Nataraajan and Warshaw (1991).

The Study

In this study, we investigate the economic rationality underlying the predictions of TRA. After all, TRA assumes rationality in behavior; the qualification "reasoned" substantiates this. It appears to us that if in fact TRA is based on rationality, it should then at least imply the notion of economic efficiency. Following from this, is the primary question, "Does TRA predict choices that are economically efficient"? Specific questions of interest are:

1. What is the proportion of economically efficient (the *homo economicus* group) consumers among those whose first choices are correctly predicted by TRA?
2. What is the proportion of economically inefficient consumers among those whose first choices are correctly predicted by TRA?
3. What is the proportion of economically efficient consumers (the *homo economicus* group) among those whose first choices are *not* correctly predicted by TRA?
4. What is the proportion of economically inefficient consumers among those whose first choices are *not* correctly predicted by TRA?

For the sake of completeness, the average number of efficient options available for the *homo economicus* and for the other group (comprising those that make inefficient choices) would also have to be determined to see if there was any unreasonable disparity.

Method

The predictive ability of TRA was tested in a hypothetical setting involving forced choice among a set of ten real apartments in a southern university town. Exhibit 1 depicts the attributes and levels on which these ten apartments differed from each other. Undergraduate business students enrolled in several marketing courses at a large southeastern university were recruited as subjects for the study. Although participation was voluntary, the subjects received points as part of their grade for "class participation." In fairness to the non-participants, those who did not wish to be subjects were given another assignment for the same number of points as part of their "class participation." In all, 117 subjects comprised the test sample.

The Prediction Phase

Subjects were provided with profile descriptions of the ten apartments along with a questionnaire. A cover letter informed the subjects that they were to assume that they needed an apartment for their own

Exhibit I
Apartment Attributes and Levels in Study I

- | | |
|--|--|
| <p>A. Monthly Rent</p> <ol style="list-style-type: none"> 1. \$150 2. \$250 3. \$350 4. \$450 5. \$550 6. \$650 | <p>B. Distance from Campus</p> <ol style="list-style-type: none"> 1. Less than one mile 2. Between 1 and 2 miles 3. Between 2 and 3 miles 4. Between 3 and 4 miles |
| <p>C. Size</p> <ol style="list-style-type: none"> 1. One room plus kitchen 2. Two bedrooms plus kitchen 3. Two bedrooms, living room plus kitchen 4. Three bedrooms, living room plus kitchen | <p>D. Renovation</p> <ol style="list-style-type: none"> 1. Throughout 2. Only kitchen and bathroom 3. Only bathroom 4. None |
| <p>E. Recreational Facilities</p> <ol style="list-style-type: none"> 1. Tennis courts, sauna, club house & pool 2. Tennis courts, sauna & pool 3. Tennis courts & pool 4. Only pool 5. None | <p>F. Washer & Dryer</p> <ol style="list-style-type: none"> 1. No washer & dryer 2. On-location (not free) 3. On-location (free) 4. In-house |

Used Car Attributes and Levels in Study II

- | | |
|--|--|
| <p>A. Year of Make</p> <ol style="list-style-type: none"> 1. 1986 2. 1987 3. 1988 4. 1989 | <p>B. Price</p> <ol style="list-style-type: none"> 1. \$7,000-\$7,999 2. \$8,000-\$8,999 3. \$9,000-\$9,999 4. \$10,000-\$10,999 5. \$11,000-\$11,999 6. \$12,000-\$12,999 7. \$15,000-\$15,999 |
| <p>C. Odometer Mileage</p> <ol style="list-style-type: none"> 1. Less than 30,000 miles 2. More than 30,000 but less than 50,000 miles 3. More than 50,000 but less than 80,000 miles | <p>D. Exterior Condition</p> <ol style="list-style-type: none"> 1. Slight rust and few dents 2. Slight rust, but no dents 3. Virtually no rust or dents |
| <p>E. Interior Condition</p> <ol style="list-style-type: none"> 1. A few stains and tears 2. A few stains but no tears 3. Virtually no stains or tears | |

use, and were to choose to rent one of the ten apartments. It also stated that while the apartments were all livable, unfurnished, located in generally clean complexes and allowed pets, they all varied on other important attributes as shown in Exhibit 1. The questionnaire consisted of two parts, one part for TRA items and the other for DEA items. To avoid

order effects/position bias, there were two versions of this questionnaire. In one version, the TRA part appeared first, and in the other version the DEA part appeared first.

For TRA, the items were A_{By} (attitude toward behavior -- purchasing a particular apartment -- for

each subject and for each apartment; y =apartment) and SN_y (subjective norm -- influencing the purchase of a particular apartment -- for each subject and for each apartment). These were patterned after the standard formats furnished by Ajzen and Fishbein (1980) and measured directly. Since prediction and not explanation was the main interest, the belief and evaluation stage of TRA (the $\Sigma b_i c_i$ and $\Sigma NB_i MC_i$ terms) was deemed quite unnecessary, and measurement took place only in the subsequent stages. This is in line with what Ajzen and Fishbein (1980) have suggested, and others (e.g., Warshaw 1980) have followed.

A_{By} was computed as a summated score of four semantic differential scales (coded from +3 to -3 or reversed depending on the polarity) with the following bipolar adjectives: 1. Pleasurable-Painful 2. Wise-Foolish 3. Unpleasant- Pleasant 4. Punishing-Rewarding. Similarly, SN_y was measured using a scale ranging from extremely likely to extremely unlikely (coded from +3 to -3).

For efficiency, evaluations through DEA, satisfaction scores were obtained. The subjects were asked to indicate their satisfaction on a nine point scale ranging from unsatisfactory to satisfactory with each of the levels of the various attributes as shown in Exhibit 1.

The Actual Choice Phase

After the subjects had completed the above questionnaire, they were given another questionnaire that required them to rate each of the ten apartments on a 0 to 100 *likelihood of renting* scale and also indicate their most preferred apartment if they had to pick one.

Analysis

The satisfaction data enabled the computation of efficiency scores for the subjects. The efficiency scores for each of the ten apartments used in the holdout were estimated at the individual level. For this, the satisfaction with the different levels of apartment characteristics was scaled per dollar rent (input) of an apartment to obtain the efficiency scores. Then, for each individual, we examined

whether his/her choice was from the set of apartments on his/her computed Pareto-frontier. This led to the determination of the fraction of subjects who chose from those apartments estimated to be on their efficiency frontiers.

Next, first choice hit rates for TRA were determined. For this, the dependent variable, BI_y , was computed as $BI_y = w_{1y} \cdot A_{By} + w_{2y} \cdot SN_y$, where w_{1y} and w_{2y} were the apartment specific beta weights. As suggested by Ajzen and Fishbein (1980), these weights were estimated from a separate and smaller sample of subjects. Thus, for each subject, 10 BI_y scores were computed. In each case, the apartment with the highest score was deemed the first choice of a subject as predicted by TRA. The predicted first choices were compared to the actual first choices, and hit rates were computed. Whether or not TRA predictions were independent of economic efficiency was tested using the Chi square test. The significance of the difference in the hit rates for the *homo economicus* group and the group that made relatively inefficient choices was conducted using a Z test for proportions.

Results

Table 1a gives the break down on efficiency and hit rates. A significant Chi square (5.56, 1df, $p < 0.02$) established the dependence between TRA predictions and the notion of economic efficiency. Overall, 58 of the 117 subjects (49.57 percent) made economically efficient choices. Also, TRA had an overall hit rate of 58.17 percent. For the *homo economicus* group, the hit rate was 68.97 percent (40 out of a maximum possible of 58), and for the other group, it was 47.46 percent (28 out of 59). The difference between these hit rates is statistically significant ($Z = 2.358$, $p = 0.018$) at the 0.02 level. Table 1b furnishes the further break down on the average number of efficient available options for each group.

Table 1a
TRA: First Choice Hit Rates
Efficiency

	Efficient	Inefficient	
Correct	40	28	68
Incorrect	18	31	49
	58	59	117

Table 1b

TRA: Average # of Efficient Options Available

	Efficiency	
	Efficient	Inefficient
Correct	5.875	5.607
Incorrect	7.167	4.970

STUDY 2: EFFICIENCY OF CONSUMER CHOICE IN MATHEMATICAL PSYCHOLOGY

As mentioned in the introduction to this paper, to the best knowledge of the authors, no one has yet investigated the choice predictions of mathematical psychology based formulations in terms of the efficiency of individual consumer choice. In this section, we report the results of an empirical investigation in the context of efficiency of individual consumer choice employing traditional conjoint analysis, possibly the most widely used tool for measuring consumers' preferences among multiattribute options (Green 1984). Traditional conjoint analysis is well documented in the literature, and one may refer to the work of Green and Wind (1975) for a brief review.

The Study

In terms of administration, this study was conducted similarly to Study 1 except for three differences. First, a traditional conjoint analysis task replaced TRA. Second, the product category employed was used cars (see Exhibit 1 for the attributes and their levels). Third, data were collected from undergraduate business students enrolled in several marketing courses at a large mid-western university. A fractional factorial design yielded a reduced stimulus set of 32 used car profiles, which were then provided to the subjects for the estimation of the part worths. Twelve realistic used car profiles culled from the classifieds were employed as part of the validation study, and the subjects were asked to indicate their most preferred profile given that they were in the market to purchase a used car.

Akin to Study 1, the individual level efficiency scores for each of the twelve used cars used in the

holdout were computed, and the fraction of subjects who chose from those used cars estimated to be on their efficiency frontiers, was determined. Next, for each subject, the used car with the highest calculated total utility score was deemed the conjoint's predicted first choice. These were compared with the subjects' actual first choice, and hit rates were computed. As in Study 1, the significance of the association between the conjoint predictions from the notion of economic efficiency as well as the statistical significance of the difference in the hit rates for the *homo economicus* group and the group that made relatively inefficient choices were tested.

A total of 106 subjects participated in the study. Of these, we had 102 usable responses as four of the subjects did not indicate their first choice from any of the available options. Table 2a gives the break down on efficiency and hit rates. Here again, a significant Chi square (6.08, 1df, $p < 0.02$) established the dependence between the conjoint predictions and the notion of economic efficiency. Overall, 65 of the 102 subjects (63.7 percent) made economically efficient decisions. The total number of correct conjoint predictions was 41 (out of a maximum of possible 102) for a predictive accuracy of 40.2 percent. The *homo economicus* group had a hit rate of 49 percent (32 out of a maximum possible 65). The other group had a hit rate of 24.3 percent (9 out of a possible 37). The difference in these hit rates is statistically significant ($Z = 2.467$, $p = 0.0136$) at the 0.02 level. Table 2b furnishes the break down on the average number of efficient brands for the consumers in the four cells.

Table 2a

Conjoint: First Choice Hit Rates

	Efficiency		
	Efficient	Inefficient	
Correct	32	9	41
Incorrect	33	28	61
	65	37	102

Table 2b

Conjoint: Average # of Efficient Options Available

	Efficiency	
	Efficient	Inefficient
Correct	4.780	4.110
Incorrect	5.760	4.500

DISCUSSION AND CONCLUSIONS

The empirical studies do seem to indicate, perhaps not surprisingly, that not all consumers make economically efficient choices. It is, however, surprising that such a significantly large fraction of the consumers do seem to choose brands primarily from those that lie on the Pareto-frontier. Consequently, the recommendation of models based on the axiom of individual consumer rationality may be more generalizable than previously conjectured.

A more interesting result arising from the experimental investigation is the potential for identifying consumers who make economically efficient decisions. A segmentation of the consumers along such lines seems to hold promise especially in the arena of optimal product design. It is of some interest to note that even when the subjects, as in this case, are walked through the process of estimating the most economical purchase (without being actually told how), we find that a large proportion of the subjects across different populations and product categories are unable to make such estimations. This, backed up by the evidence of an older study by Friedman (1972) on unit pricing, seems to suggest that perhaps the only way to avoid such large consumer welfare losses may be through expanded policy initiatives such as public education programs.

Additionally, the consumer welfare losses may be larger than their pure numerical estimate of the population. That is to say, these losses may be further compounded by the magnitude for the "inefficient" consumers. To put it differently, as both the social psychological (TRA) and mathematical psychology (conjoint) models predict consumer choices better for the efficient decision makers, it is only natural that products and services will continue to be better designed and targeted to

this group. However, it may now be possible through the use of DEA based models to identify consumers who may be unable to engage in the requisite cognitive processing of information. This in turn may lead to the better targeting of public policy programs. In any case, it is clear that the concept of efficiency (or inefficiency) of consumer choice deserves further investigation, especially given the result that predictive validity of both the theory of reasoned action and traditional conjoint analysis for the individually rational consumer segment is significantly higher than that for consumers who make relatively inefficient choices.

Efficacy of DEA: An Assessment

DEA can aid decision makers by summarizing the wealth of information about the inputs expended and the outputs obtained for each brand in a product category. It allows us to represent concisely, for a consumer, the relative efficiency of the different options. Thus, consumers, having identified the salient attributes, can then easily determine how the different brands stack up relative to one another. In addition, DEA does not assume, unlike most strategic models (Hauser and Shugan 1983), that all choice alternatives for a consumer are efficient. Further, it does not require homogeneous consumer perceptions as each consumer could have different salient attributes and differing performance perceptions for the same brand. This is especially important when one considers that DEA is employed at the individual level and its output can therefore be used as benchmarks or basis for further discussions. Importantly, DEA is adaptive in nature in that it allows for a combination of choice strategies on the part of the purchaser.

Furthermore, DEA is able to explicitly take into account that consumers might, and in fact do, consider a number of different aspects along which they may have to "invest" in order to obtain the multiple benefits a product has to offer. For instance, the advertisement campaign by Apple Computers (before or after their resurgence!), which explicitly suggests that their products are superior to those of their competitors is a case in point. In this campaign, the case for the superiority of the product is made by emphasizing that Apple computers are

more efficient since the users require much less training before the products can be fruitfully used. In other words, the lower training and support costs of this particular product translates into higher overall efficiency (even with performance on all other attributes being the same). However, this aspect of DEA, which is both a strength as well as a weakness, is that the axes, unlike, say, in multidimensional scaling, are explicitly defined. In any case, the results presented here, although preliminary, strongly suggest that DEA certainly has the potential for use as a tool for operationalizing the Lancasterian model at the individual level.

Future Directions

A number of avenues for future research are now open, and deserve attention. First, various issues relating to data collection need to be examined. For instance, the approach taken here requires subjects to indicate their utility of satisfaction with all levels of each attribute. Thus, this approach requires as many questions as the total number of attribute levels employed in the study. Additional research to investigate the possibility for reducing data collection from subjects needs to be undertaken.

Another critical issue, namely that of multiple efficient points, deserves to be addressed. Note that the efficiency score obtained for E (Figure 1) is with respect to the frontier defined by the cars A and B. Other inefficient cars would be compared to other facets of the frontier. These different facets essentially represent different trade-off rates or weights for the attributes. Thus, information on their relative weights for the attributes can be used to determine which facet of the frontier is the most desirable and thereby reduce the size of the choice set. This means that it could be possible in the future to predict the alternative model that would be most preferred. In other words, extending this approach has the added potential for identifying the brand that will be chosen by each consumer.

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