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Can Economists Contribute to Marketing Research?

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Can Economists Contribute to Marketing Research?

I have felt for a long time that there ought to be useful connections between the economist's approaches to consumption theory and the work done by market researchers for consumer goods. There is, of course, a difference : economists usually consider broad product classes, and market researchers tend to look at more narrowly defined goods or even brands of goods. However, this difference can be handled under appropriate conditions.

Consumer Utility and Demand Functions

During a number of weeks last autumn I did a lot of reading in the *Journal of Marketing Research* and other journals, partly in an effort to educate myself, and partly in order to find out whether my own work in consumption theory is or can be made useful for the problems considered in these articles. What I found in many articles in the marketing journals is very econometric but also very uneconomic. These articles are very econometric in the sense that there are numerous Durbin-Watson statistics, Koyck distributed lags, and even simultaneous equation systems. Yet, the articles are very uneconomic in the sense that they say very little about consumer utility.

Whenever an economist thinks about a consumer, he does so in terms of utility maximization subject to a budget constraint, or some mathematically equivalent version of this idea. The economist postulates that the consumer has certain preferences which can be described by a utility function. The budget constraint describes the consumer's financial limitations. By maximizing the utility function subject to the budget constraint, the consumer finds the optimal quantities to be bought of the various goods and services (optimal in the sense that they are best according to his tastes without violating his budget constraint). These optimal quantities depend on the amount of income which is at the consumer's disposal and on the prices which he has to pay for the goods and services. This dependence is formalized in terms of a set of demand functions, each of which describes the demand for a good or service in terms of income and prices.

The numerical specification of demand functions is a useful scientific project. We want to know the numerical values of income and price elasticities of demand. This kind of work has been going on for more than a century: Engel's Law, proposed in 1857, states that when income increases, the amount spent on food also increases, but that the proportion of income allocated to food becomes smaller. (This amounts to an income elasticity of the demand for food which is positive but less than one.) In 1943, Holbrook Working used family budget data for a further specification of this relation; he found that the proportion of income allocated to food could be closely approximated by a decreasing linear function of the logarithm of income.[1] Recently, Kenneth Clements and I found that this relation also applies, in a cross-country context, to per capita food expenditure in fifteen countries at different states of economic development, ranging from India to the United States.[2]

When I speak about expenditure on food, I recognize that I am far from the level of detail in which most marketing researchers are interested. Nevertheless, such a discussion provides perspective; I want to use this argument to engage in a short digression on parallel developments in the theory of the firm.

Whereas consumption theory is based on the notion of utility maximization subject to a budget constraint, the theory of the cost-minimizing firm assumes that this firm minimizes the total amount spent on production factors (or inputs) subject to a technological constraint in the form of a production function. This constrained minimum problem is equivalent to the dual problem of maximizing output subject to a budget constraint, in the sense that a fixed total amount is spent on the inputs. Note that maximizing output subject to a budget constraint for a firm is comparable to maximizing utility subject to a budget constraint for a consumer. This similarity is one reason for this digression. A second reason is that there is an important difference: the output of a firm can be measured (at least in principle), whereas utility is a more abstract concept.

Consumer Demand Equations in Marketing Research

How can we make this abstract concept useful in marketing research? Let me list a number of problems that are important in marketing research for consumer goods. The list is my own and probably reflects my biases, although I had the benefit of discussions and correspondence with others.[3] In this article I will make a distinction between a product or product class, such as coffee, detergents, or soap, and a particular brand sold by one firm within that product class. Here are the problems:

- How sensitive are the sales of the product to a change in economic conditions, such as an increase or decrease in the consumer's real disposable income?
- How does this affect the market share of my brand?

- How sensitive are the sales of my brand to a change in my price and to changes in the prices of my competitors?
- How effective are promotional techniques in inducing consumers to buy the product ?
- How effective are my promotional techniques in inducing consumers to buy my brand?
- How effective in this regard are the promotional techniques of my competitors?
- If such techniques have a lagged effect on demand, what is the form of the lag?
- What is the effect of shelf space, package design, etc., on the market share of my brand?
- To what extent are the purchasers of my brand loyal, in the sense that they keep buying it?
- What kind of people are loyal to my brand and what kind are not?
- Why are some people loyal to my brand and others not?
- How can I create more brand loyalty?
- How can I change the composition of my brand and the package design to make it more salable ?
- Should I design my brand to target on particular market segments and, if so, which ones?
- Should I introduce new brands in order to capture market segments which are not covered by present brands?

I presume that you do not expect me to provide an answer to all of these questions. I listed them approximately in the order of increasing difficulty which I face when I try to answer them.

Some of these problems can be solved when we use certain recent developments in the economic theory of systems of consumer demand equations. There is a gap between these developments and the current marketing research literature on the price and advertising effects on the demand for narrowly defined goods. The existence of such a gap is understandable, because most of the economists' attempts to model consumer behavior in a system-wide manner refer to the consumer's total expenditure, not to the expenditure on a particular product class. This necessitates the use of broad groups of consumer goods. However, it is possible to formulate subsystems for more narrowly defined goods under appropriate separability conditions on the consumer's preferences. When such a subsystem refers to the brands of a particular product, it contains only the prices and quantities of these brands, not of the goods outside the product class under consideration. This is an attractive feature from the viewpoint of a marketing researcher who is particularly interested in this product and its brands.

The Specification of Demand Equation Systems

I will now describe the way in which this separability procedure works. The literature on separability is substantial, and much of it is in rather abstract mathematical terms,[4] which is probably one reason why it has not penetrated much into marketing research. The simplest way to proceed is by postponing separability until the next stage.

The first stage in estimating consumer demand functions is to maximize the utility function subject to the budget constraint.

This yields equilibrium conditions in the form of the familiar proportionality of marginal utilities and prices. We can then obtain algebraically specified demand functions by specifying a particular algebraic form of the consumer’s utility function. The best-known specification is the Klein-Rubin utility function.’ This function implies the so-called linear expenditure system; that is, the expenditure on each good is described as a linear function of total expenditure and the prices of all goods. This model has become particularly popular since Richard Stone applied it to British data in 1954.[5] Note that the model provides a complete system of consumer demand equations. This is shown by terms such as the system-wide approach or the equation systems approach. It should be contrasted with the older approach, which estimates demand equations individually rather than as a system.’

The linear expenditure system is obtained from an algebraic specification of the consumer’s utility function. There are several other ways in which demand systems can be derived. For example, we can provide an algebraic specification of the so-called indirect utility function, which describes the maximum utility level that is attainable for given values of income and prices. We can also algebraically specify the consumer’s cost function, which describes the smallest amount of expenditure needed to attain a given utility level at given prices. The cost function is of particular importance in the theory of the cost-of-living index and the real-income index. This theory is also relevant in marketing research, because price and volume indexes are important when we consider a set of closely related, narrowly defined goods, such as brands of the same product class.

Differential Consumption Theory

The differential approach postpones the matter of algebraic specification. Noting the prominence of partial derivatives in demand theory will put this approach in appropriate perspective. The income elasticity of demand for a good is a logarithmic derivative with respect to income. The Slutsky equations decompose price effects into income and substitution effects. Slutsky negativity amounts to a negative derivative of the demand for each good with respect to its own price, provided that an appropriate correction is made for the fact that a price increase makes the consumer poorer. There is also Slutsky symmetry, which relates the derivative of the demand for good A with respect to the price of good B to the derivative of the demand for B with respect to the price of A (after similar corrections).

The differential approach to consumption theory goes one step further by collecting these income and price derivatives in the form of differentials; that is, the differential of the demand for each good is written as a weighted sum of the differentials of income and prices, with weights equal to the corresponding derivatives. Most applications of the differential approach use time series data, in which case the differentials are simply changes over time. But this is an unnecessary restriction; there are also applications in a cross-country context, in which case the differentials are interpreted as moves from any country to any other country.'

What can we learn from the differential approach to consumption theory? Does it enable us to statistically test and impose Slutsky symmetry ? Does it tell us something about the form of price indexes which transform money income into real income and absolute prices into relative prices? The answer is yes; to clarify this optimistic statement, I will proceed under the assumption that we work with time series data, so that the abstract differentials take the more familiar form of changes over time.

Effects of Price Changes on Demand

An important result is that when the price of any good changes, the demand for this good, and also for any other good, is affected in three distinct ways. One of the three components of the effect of a price increase on demand reflects a reduced affluence, or a decline in real income. This is the income effect of a price change on demand, which can be conveniently visualized as a deflation procedure which transforms money income into real income. The deflator used is the Divisia price index, which is obtained by weighting the logarithmic price changes of the individual goods proportionally to the amounts spent on these goods.[9]

The two other components of the effect of a price change on demand reflect a change in relative prices, or of price substitution. There are good reasons for a separation of the substitution effect into two components. One reason is that whereas all goods compete with each other for an extra dollar of the consumer’s income, there are usually certain pairs of goods which compete with each other because they are closely related, such as different brands of the same kind of product. Also, other pairs of goods, such as cars and gasoline, complement each other. The general competition of all goods for an extra dollar of the consumer’s income results from the consumer’s budget constraint; this component of the substitution effect is known as the general component of the substitution effect or, more shortly, the general substitution effect. The other component results from the interaction of the two goods in the consumer's utility evaluation and is known as the specific substitution effect. The distinction between these two components is from Houthakker.[10]

Price Deflators

The most straightforward way to handle the two components of the substitution effect (also from the viewpoint of the application to narrowly defined goods, such as different brands of the same product) is to use the general substitution effect as a deflator of the specific effect. This yields the following picture of the differential demand system. First, the change in the demand for each good depends on the change in money income. Next, the change in demand depends on the income effects of the price changes. This is formulated in terms of a deflator which transforms money income into real income; the deflator used is the Divisia price index. Further, the change in demand depends on the changes in relative prices. This is formulated in terms of changes in prices deflated by a price index. The price changes that are deflated represent the specific substitution effect, and their deflator represents the general substitution effect.

This deflator is not identical to the Divisia price index which transforms money income into real income. Most price indexes, including the Laspeyres and Paasche indexes (which date back to the nineteenth century), can be viewed as approximations of one kind or other to the Divisia index. The Divisia index weights the logarithmic changes in the prices of the individual goods with their budget shares, which are the proportions of income allocated to the individual goods. By contrast, the price index which represents the general substitution effect as the deflator of the specific substitution effect is the Frisch price index.[11] This index weights the logarithmic changes in the prices of the individual goods with their marginal shares.

These marginal shares answer the following question: Suppose that income increases by one dollar; what is the additional amount spent on each of the goods? In general, the answer will differ from the budget share. In fact, it is not difficult to show that the ratio of the marginal share of a good to its budget share is equal to the income elasticity of demand for this good. It is only under the unrealistic assumption that all goods have unitary income elasticities that the marginal and budget shares are pairwise all equal. Such an assumption is particularly unattractive when we are interested in brands of the same product, because high-quality brands will have higher income elasticities than low-quality brands.

The existence of two different price deflators (Divisia and Frisch) is one of the interesting features of the differential approach to consumption theory. This approach yields a demand system which describes the change in demand in terms of the income change deflated by the Divisia price index and the Frisch-deflated price changes of all goods. However, this result does not yet enable the market researcher to analyze the market of his interest conveniently. The problem is that the Frisch-deflated price changes of all goods include prices of goods outside the market in which he is interested. To solve this problem, we turn to separability conditions on the consumer's preferences.

Separability and Preference Independence

The simplest and most drastic separability condition states that the consumer's preferences can be described by a utility function which is the sum of a number of functions, one for each good. This implies that the marginal utility of each good is independent of the consumption of all other goods; accordingly, this preference structure is frequently referred to as preference independence. The Klein-Rubin utility function which underlies the linear expenditure system belongs to this category, since it may be written in additive form.

If the consumer is preference independent, we can write the differential demand equations in a particularly simple form, viz., so that the substitution component of the change in the demand for each good depends only on the change in its own Frisch-deflated price. In addition, the own-price elasticities, i.e., the elasticities of the demand for the goods with respect to their own Frisch-deflated prices, are then proportional to their income elasticities. A rudimentary version of this proportionality was discussed by Pigou many years ago.[12]

There are several other interesting features of preference independence, particularly regarding the behavior of the proportionality coefficient in the relation between income and own-price elasticities,[13] but I will ignore these matters here, because preference independence is too restrictive for narrowly defined goods. It is simply not realistic to assume that the marginal utility of a dollar spent on brand A is independent of the consumption of brand B when we consider brands of the same kind of product. However, a weaker version of preference independence, called block-independence, is more promising.

Block-Independence

Let us divide the consumer goods into a number of groups, and assume that one of these groups consists of certain more narrowly defined goods in which the market researcher is interested. Also assume that the consumer's preferences can be represented by a utility function which is additive, not in the individual goods, but in the groups; that is, utility is the sum of a number of group utility functions. This implies that the marginal utility of each good is independent of the consumption of all goods that belong to different groups. It also implies that the change in the demand for each good is independent of the changes in the Frisch-deflated prices of all goods belonging to different groups.

The most interesting features of this block-independence specification become apparent when we consider the composite demand equations for the groups and the conditional demand equations for individual goods within their group. The composite demand equation for a group is obtained by simply adding the demand equations for its constituent goods. The form of a group demand equation under block-independence resembles the individual demand equations under preference independence. The change in the quantity consumed is now measured by the Divisia volume index of the group; this index is obtained by weighting the logarithmic quantity changes of the goods of the group in proportion to the amounts spent on these goods. This volume index contains a substitution component which depends only on the Frisch-deflated price index of the group, and this index is itself a Frisch price index. Price substitution at the group level can be expressed in terms of own-price elasticities, which are proportional to the income elasticities of the groups. All these features are simply group extensions of the corresponding properties of the demand equations for individual goods under preference independence.

Conditional Demand Equations

Next, by appropriately combining the demand equation for one good of a group with the corresponding group demand equation, we obtain the so-called conditional demand equation for this good within its group. This version is, in my view, one of the more promising developments of modern consumption theory for application in marketing research. A system of conditional demand equations enables the analyst to concentrate his attention on a group of related goods.

For example, we may consider beef, pork, chicken, and lamb. Each of these meats has a conditional demand equation within the group of all four meats jointly. Such an equation describes the change in the demand for a meat in terms of the Divisia volume index of meat and the changes in the four meat prices; no prices of other goods enter into the picture. Application of this model to U.S. data for the period 1950-1972 yields the result that beef and lamb are the most luxurious among the four meats.[14] The luxury character of such goods is measured, as usual, by their income elasticities; when we use conditional demand equations, we can obtain statistical estimates of the ratios of income elasticities of individual goods to the income elasticity of the group.

The picture that emerges from the previous paragraphs can be most easily visualized as a decision hierarchy. In the first stage, the consumer considers groups of goods, not individual goods; he decides how to allocate his income to these groups. In the second stage, he decides how much to spend on each good within its group. That second stage, represented by conditional demand equations, is completely confined to the group, as far as price changes of individual goods are concerned.

This is a very convenient feature, but note the underlying assumption of block-independence: utility equals the sum of group utility functions. This assumption can be somewhat relaxed; utility may be some increasing function (rather than the sum) of the group utility functions. The conditional demand equations take the same form under this weaker assumption.[15] Nevertheless, we have to make some separability assumption on the consumer's preferences in order to justify the absence of prices of goods outside the group in which we are interested.

The analysis of conditional demand systems also requires a statistical assumption. Demand equations do not hold exactly: a random disturbance is added to the right-hand side. Thus, a conditional demand equation describes the change in the demand for a good in terms of the Divisia volume index of the group, the price changes of the goods of the group, and a random disturbance. It is typically assumed that this disturbance is stochastically independent of the Divisia volume index; we run into serious statistical difficulties when this assumption is not true.

There is a problem because the Divisia volume index is a random variable in the composite demand equation for the group. The random component of the Divisia volume index is the disturbance in the group demand equation. Therefore, we must assume that the group disturbance is stochastically independent of the disturbances of all conditional demand equations. Is this realistic? A casual look at this problem suggests that there is no reason why this should be so, but a more extensive analysis based on the theory of rational random behavior provides equations, is completely confined to the group, as far as price changes of individual goods are concerned.

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Conditional Demand Systems and Marketing Research

There are several features of conditional demand systems which can be conveniently discussed in conjunction with certain questions raised in marketing research. For example, what are the positive features of a brand which induce customers to buy it? (We should also ask whether there are any negative features which induce customers not to buy it.) One possible answer to these questions is based on the preference independence transformation. Recall that preference independence implies that the consumer's tastes can be represented by a utility function which is additive in the individual goods. This is an unrealistic assumption for narrowly defined goods, but it is always possible to transform goods so that preference independence prevails after the transformation. This procedure yields transformed goods, each of which has a marginal utility that is independent of the consumption of all other transformed goods. This means that the consumer's utility function becomes additive after the transformation, which can be interpreted in the sense that each transformed good is associated with one of the consumer's basic wants. Statistically, the transformation can be viewed as a constrained principal component transformation; the constraint results from the fact that the transformed goods are required to satisfy the budget constraint, and that the Divisia price and volume indexes are required to be invariant.

For example, when we apply the transformation to U.S. data on the consumption of beef, pork, and chicken, we obtain three transformed meats. One of these dominates the two others in terms of the amount spent on it, and it also has the lowest income elasticity, suggesting that this transformed meat is associated with the consumer's basic want for affordable meat. A second transformed meat represents beef positively, pork negatively, and chicken hardly at all, implying that it is associated with the consumer's desire to have beef rather than pork. This transformed meat is the most luxurious of the three: it has the highest income elasticity. The income elasticities of transformed goods are obtained from the latent roots of the principal component transformation which is associated with the preference independence transformation.

The preference independence transformation, in contrast to the principal component transformation, is unique. Principal components are not unique; they change in value when the original variables are measured in different units. The preference independence transformation does not have this problem because of the constraints which it is required to satisfy. From a more economic point of view, the transformation resembles Lancaster's work" on basic characteristics of consumer goods, but it has the advantage of being more directly applicable on the basis of the estimated price coefficients of differential demand systems."

The estimation of these price coefficients requires consideration of the size of the demand system. There are no great problems when we analyze three or four meats, but problems do arise and increase in complexity when we consider larger models. The number of price coefficients tends to increase almost proportionally to the square of the number of goods. When we impose constraints across equations such as Slutsky symmetry, it becomes necessary to estimate all equations jointly rather than individually. The problem is not that our computers are not big enough; rather, our data base is insufficient relative to the number of coefficients to be estimated.[19]

Equicotrelated Substitutes

The most satisfactory solution to this problem is the formulation of plausible constraints on these coefficients. I attempted to do this for a set of brands which can be viewed as variations of the same theme.[20] The underlying assumption refers to the impact on the marginal utility of a dollar spent on a brand of an extra dollar spent on a different brand. Such effects are treated in a uniform manner for all pairs of brands; the result is that the relevant submatrix of the Hessian matrix of the utility function resembles the covariance matrix of a random vector of a special form, viz., so that all pairs of elements of this vector have the same correlation coefficient. Accordingly, brands which satisfy this preference structure may be called equicorrelated substitutes. This statistical formulation will sound a bit unusual to those who are not accustomed to merging economics and statistics, but it does have an interesting precedent. As early as 1932, Harold Hotelling proposed correlation-type measures for the description of the effects of price changes on demand.[21]

Conditional demand systems for equicorrelated substitutes satisfy the requirement of a modest number of unknown coefficients.

Whether this specification is realistic for the brands of a particular product is a matter that can be decided on!y on the basis of statistical data. It may well be the case that it is more realistic to introduce different correlations for subgroups, such as domestic brands and imported brands. If the model or some extension of this model appears acceptable, it would be interesting to verify whether the implied income elasticities of the brands are positively associated with their prices. Such a relation could be used to obtain more accurate coefficient estimates.

Quality

It is worthwhile to pursue this matter a little further, because a high income elasticity of a brand may be viewed as an indication that consumers consider this brand to be of relatively high quality. The measurement of the quality of consumption is a hot topic these days which can be approached from various angles. For example, we can consider certain desirable characteristics, such as the length, weight, and engine horsepower of an automobile. This approach is used in the theory of hedonic price indexes, on which there is an extensive literature,** but it faces difficulties when it tries to handle subjective characteristics.

An alternative procedure is to let the consumer decide what is high quality and what is low quality. Since income elasticities are behavioral characteristics, one way of doing this is by registering a shift to high income-elastic goods away from low income-elastic goods as a quality increase, and a shift to low income-elastic goods as a quality decrease. This can be done very elegantly in terms of the weighted covariance of the income elasticities and the logarithmic quantity changes, using the budget shares as weights. This formulation has the advantage that the income and substitution components of the change in quality can be easily established. It appears that the income elasticity of the demand for quality is equal to the variance of the income elasticities of the individual goods.

Clements and I applied these ideas in a cross-country context to consumption patterns of fifteen countries.‘” We estimated the pairwise quality differences for these countries and their real-income and substitution components, and found that the differences in real income and relative prices account for 88 percent of the quality differences. These computations are based on broad product classes, but the results should be inspiring for those whose interest is in more narrowly defined goods.

Closely Related Products and the Effects of Advertising

There are several problems regarding these narrowly defined goods which must still be discussed. Frequently the prices of goods which are brands of the same product move up and down more or less proportionately. How can we estimate price substitution among such goods when there is little or no change in their relative prices? How can we estimate the effect on the demand for these goods of various forms of promotion, such as advertising?

It will be convenient to start with the second question, because under certain conditions the answer also provides a solution for the first. Let us model the effect of advertising in terms of an assumed effect on the marginal utility of the promoted brand. If this is done judiciously, only one additional parameter is needed to describe the advertising effects on demand in a full system of conditional demand equations.‘” Basically, advertising effects are absorbed into the substitution terms; what counts is the changes in relative advertising for the goods involved, in the same way that price substitution involves changes in relative prices. Since the substitution terms contain advertising effects, we can estimate the coefficients of these terms even when there are no changes in relative prices; it is sufficient that there be changes in relative advertising (which provides an answer to the first question raised above). Also, it is possible to link this approach to the Dorfman-Steiner theorem on price and advertising elasticities.[25]

These results look promising and perhaps even exciting, but several qualifications are in order. This approach, in the tradition of comparative statics, ignores the possibility of lagged effects of advertising on demand. This shortcoming can be remedied by adding lagged terms in the style of the Nerlove-Arrow approach to optimal advertising under dynamic conditions.[26]

A more fundamental question concerns the assumption that an increase in advertising affects demand via an increased marginal utility of the brand which is advertised. This is an obvious approach within the utility framework, but it is not obvious that this is always a satisfactory assumption. Suppose that we extend the advertising concept so that it includes shelf space. Does an increase in shelf space raise the marginal utility of a brand? Probably not, since shelf space is not an attribute of the brand.

Professor Robert Ferber, the editor of the and a former editor of the *Journal* of ***Marketing Research,*** as well as the *Journal* of ***the American Statistical Association,*** suggested that I make a distinction between objective and subjective attributes. Objective attributes are inherent in the brands, while subjective attributes are external to the brand and are created by marketing strategy. For objective attributes we could expect a relationship with the consumer’s marginal utility, whereas subjective attributes would require a different treatment. One possibility would be the application of Stigler’s theory of the economics of information to advertising, but the integration of this theory and the differential approach is still a task for the future.”

Conclusions

The differential approach has proved to be applicable to areas other than consumption theory, such as the theories of the cost-minimizing and profit-maximizing firms.[28] This has led to:

- Differential input demand systems and output supply systems;
- An interesting independence property of input demand disturbances and output supply disturbances under rational random behavior;
- An input independence transformation and an output independence transformation which may be viewed as the firm’s version of the consumer’s preference independence transformation;
- An intriguing picture, based on Shephard’s lemma, of the consumer as a profit-maximizing firm which sells utility to itself.*’

The theory of the cost-minimizing firm can be used to endow Leontief’s input-output relations with substitution terms.“’ This theory has also been applied to international trade for the estimation of systems of import demand equations.[31] Such applications require strong assumptions. For example, the international trade application proceeds under the heroic assumption that a nation can be viewed as a cost-minimizing producer of its gross national product, with a technology that is appropriately separable in terms of domestic and foreign inputs. By contrast, the application to marketing research is a matter of paying attention to detail. It is the respect for detail that gives marketing research an advantage relative to macroeconomics.