

A Critique of Economic Man Theories of Quality

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ABSTRACT

The theories of quality based on the assumption of rational economic man are examined. The fundamental assumptions on consumer preferences and supply are shown to be counter to observed reality in virtually all instances, and not to be in any sense simplifications of reality. The fundamental assumptions on objective quality factors or characteristics limit the application of the theory to a small number of possible applications - they rule out much of mainstream economics, for instance. The very restrictive boundary assumptions further limit possible application. The *ad hoc* assumptions make it unlikely that any situation exists which is at all like that assumed.

Logical errors arise from confusion between the theory appropriate to choice between goods and that for the choice between goods of different characteristics composition. Logical errors also arise in the use of 'characteristics space' which invalidate the analysis.

It is not possible to determine that the fundamental assumptions, on shape of indifference surfaces for instance, hold in any instance, so it is formally impossible to test the predictions of the theories under most epistemologies. Well-recognized problems make it impractical under others. No attempt has been made at a programme of tests large enough to 'validate' or 'add corroboration to' any of these rational economic man theories.

These weaknesses are shown to be fatal under five different epistemological approaches.

INTRODUCTION

One influential group of theories of quality is based on a perfectly rational economic man making optimal choices between goods on the basis of the objective characteristics of those goods, with perfect knowledge about these characteristics and their prices. These may be referred to as REM (rational economic man) theories. These theories are dominant in mainstream economics and important in market economics and marketing. The seminal works are Lancaster (1966, 1971, 1979)¹, Rosen (1974), Houthakker (1952), Thiel (1952) and Brems (1948, 1957). They share some fundamental assumptions, though their analysis develops in different directions. There are now more than 10,000 papers in the REM literature. Some of them are extremely complex and have developed a long way from the original formulations, but they still ultimately, and crucially, rely on the REM assumptions.

This paper analyses the fundamental framework underlying REM approaches to quality, arguing that they contain fatal weaknesses. The analysis is of fundamental issues common to all or nearly all theory based on REM, and particular emphasis is laid on Lancaster, not just because his work continues to be the most widely cited and

¹ With Becker (1965), Muth (1966), Gorman (1956) and Ironmonger (1972) presenting similar theory less influentially.

used in quality theory and his 1966 paper is one of the most widely cited in economics, but because he is particularly clear and rigorous in establishing the formal foundations of the research programme. The criticisms affect all theory that shares any part of his fundamental framework.

It is argued that the theories fail for the following reasons: the fundamental assumptions conflict with observed reality (that is to say they are in no sense a simplification of reality), the boundary assumptions are extremely limiting, the many *ad hoc* assumptions effectively rule out all possible situations, there are significant logical and conceptual errors, and it is formally impossible to test the predictions of the theory, directly or indirectly, against reality. Each of these is discussed in turn. It is acknowledged that different schools of thought in economics vary in the epistemological rationales they use for accepting or discarding theories. Five of these rationales are briefly explained in order to demonstrate that this combination of weaknesses is fatal under all of them.

No view is presented about the best alternative to REM. It would be naive to present an alternative theory here, both because there is inadequate space available for an adequate presentation, and because there are already many established alternative theoretical approaches in general use. In marketing, for example, there are the hedonic approach, compensatory models, perceived quality, behavioural, behaviourist and heuristics approaches, which do not depend crucially on REM assumptions. One may weed the garden without first showing that one can breed a hybrid orchid. The author's own preference is for the composite and complex approaches based on a range of theory and a wealth of rigorous observation to be found in marketing, in market economics (e.g. Bowbrick, 1992), in agricultural economics, and in the new mainstream economics (e.g. Earl 1986).

FUNDAMENTAL ASSUMPTIONS

Nearly all epistemological approaches to economics require that theory should be based on assumptions that are realistic and non-trivial. There is disagreement about the degree to which simplification is desirable, whether arising from simplification of each assumption or limitation of the number of assumptions made, but it is seldom argued that assumptions which are contrary to observed reality are acceptable. There is an infinite number of possible theories based on unrealistic or trivial assumptions, but these are not considered to be economics. It is shown in this section that the fundamental assumptions common to the REM theories are contrary to observed reality rather than being simplified: they do not approximate to the situation for any product in any market.

The fundamental assumptions are the ones which cannot be dropped without abandoning the whole theory. In the case of the seminal papers, the second and all

subsequent stages of the analysis are invalid if they are dropped. In those recent papers which base a large, complex argument on any of these assumptions, with a long chain of logic, the effect is serious: even a small change can invalidate the analysis: ‘for the want of a nail a kingdom was lost.’.

The papers in the REM programme share common fundamental assumptions on consumer preferences, characteristics space, supply price and objectivity, though the theories develop in different directions, with further assumptions, boundary assumptions and *ad hoc* assumptions. The discussion will start with the assumptions on consumer preferences.

Assumptions on Consumer Preferences

In REM theory, a good is usually defined as a unique mix of characteristics, so one combination of colour, crispness, acids, and sugars makes the good, Granny Smith apples. Apples in general are a group of goods. The objective properties of a good are called ‘characteristics’, while an individual’s subjective perceptions are called ‘attributes’.

The fundamental assumption on consumer preference is that the individual consumer values each characteristic positively, and that the indifference curve for two characteristics is similar in shape to the textbook indifference curve for two goods (Figure 1). The most rigorous exposition of this is provided by Lancaster (1966,1971, 1979) who shows that the assumptions of transitivity, completeness, continuity, strict convexity, non-satiation and all characteristics positively desired are necessary if the analysis is to proceed on the broader assumption ‘that the consumer’s preferences can be expressed in terms of an ordinal utility function of the neo-classical kind, with all its first order partial derivatives positive’. These assumptions are, therefore, fundamental.

There is a basic conceptual error here. The indifference analysis which has been developed for two *goods* which may be bought and consumed separately cannot be used without major changes for two *characteristics* of a good, because these characteristics are necessarily bought together and usually consumed together. Preferences between butter and blankets (two goods), for instance, bear little relationship to one’s preferences for chocolate with different levels of peppermint flavouring and nuts (characteristics which come with the good and which the consumer cannot alter)

Consider a good consisting of two characteristics which the consumer values separately, where the utility obtained from characteristic A is independent of the level of characteristic B, and where there is first increasing, then constant, then declining utility, as is normally assumed in economic analysis. The preference map is shown in

Table 1. When marginal utility is rising, customers will prefer to buy a good which is all characteristic A or all characteristic B, giving an indifference curve which is *concave*, contrary to the fundamental assumption. As the level of characteristic rises, the indifference curve becomes first convex, then concave again, as marginal utility declines then becomes negative. There is a bull's eye around the point at which maximum utility is obtained. Since the two characteristics are part of the same good, changes can only be made by buying a different good (i.e. a different quality of the same product). It is possible to obtain a range of shapes of indifference curve by adjusting the assumptions on marginal utility, but to get the shape shown in Figure 1, it is necessary to make the extreme assumption that there is a positive but declining marginal utility at all levels, and that this is so for all characteristics of the product at all times. This is not a usual explicit assumption in economics, which suggests, as does common experience, that such curves must be rare in practice.

The assumption made in this example, that the two characteristics were valued independently, was made to be favourable to REM theories. In practice, it is normal that a good is valued by the ratio and proportion of its characteristics, so that the utility obtained from characteristic A depends on the level of characteristic B. This can be seen in Figure 2, which shows preferences between bottles of wine containing different levels of sugar and acid. The indifference curves indicate a preference for a medium-sweet, medium-acid wine (this is shown at the centre of the bull's eye). If a wine has less acid, it may be seen as bland, if more acid, as sour. If it has less sugar, it may be seen as dry, if more sugar, as sickly sweet. It certainly is not the case that the consumer prefers the wine with the maximum level of the characteristics sugar and acid, as the assumptions of Lancaster, Rosen, Houthakker and others imply.. Here the assumptions of strict convexity, non-satiation, and all characteristics positively desired clearly do not hold. This bull's eye arises because consumers prefer certain proportions of sugar and acid, and it is not necessary to make the same assumptions on marginal utility for single characteristics used for Table 1: it can arise even where there is a positive but declining marginal utility at all levels, as long as these two characteristics continue to be consumed in the same proportions.

Preferences also conflict with the fundamental assumptions for other products and other combinations of characteristics . Figure 3 shows the indifference curves for the sugar and acid in apples. Here there are two distinct peaks, medium-sweet, medium acid when the apple is to be consumed as a dessert apple, and very sweet, high-acid when the apple is to be cooked (a Bramley for instance). Certainly this arises because of different end uses, but a major attraction of REM models based on objective characteristics is that they claim to work independently of the end use of the product or of individual consumers' preferences. Such multiple peaks are common, and some arise not from different end uses but from the laws of physics. Figure 4 shows two peaks in the temperature at which superconductivity is obtained from a mixture of two

characteristics, when the utility depends on this temperature (Emsley 1990). Again, consumer preferences for a chord containing two notes as characteristics, show peaks when the two notes are identical or an octave apart, with lower points at discords in between.

Empirical work produces other curves which do not conform to the assumptions of REM theory. Figure 5 shows an individual's preferences for the amount of sugar and tea in a cup (Huber, 1974). This individual is happiest with five spoonfuls of sugar over a wide range of strengths of tea (the colour of the tea was kept constant in this experiment). Again, these shapes of indifference curve conflict with the fundamental assumptions.

Where a pure product is preferred to a mixture, again a common phenomenon, the curve is again concave (Figure 6).

Different shapes of curve can also be obtained by redefining the characteristic, by talking of fructose or 'apple sweetness' instead of sugar as the characteristic.

Contamination is a potential problem with all products. A product which may be valuable when it is a good by itself, like insecticide, diesel oil, or manure, is just a contaminant when it becomes mixed with a product like milk, and is no longer a good, but one characteristic of a good 'milk in a bottle'. Here it has a negative value, and milk with more than a certain amount of the contaminating characteristic cannot be sold (and equally, diesel with more than a certain amount of milk as a contaminant cannot be sold). It is clearly not possible for a consumer who buys a bottle of contaminated milk to extract the diesel oil or the pesticide from the bottle and use it for some other purpose: the good and the contaminant must be consumed together. This is shown in Figure 7 where the diagonal is the product possibility curve: 100 per cent of the contents of the bottle. If no contamination is acceptable, the only points on the indifference curve are where the axes meet the diagonal. More commonly, as in Figure 8 some contamination is acceptable. Since *all* products can be unacceptably contaminated by a range of characteristics, the indifference surface for *all* goods will contain many curves like this. REM theories on the other hand, assume that there are *no* indifference curves like this, because if they do exist, the REM analysis cannot proceed to its first step, optimum consumer choice.

It must be concluded therefore that the fundamental assumptions on preference of REM theories of quality are false: they are contrary to observed reality, and in no sense a simplification of a complex reality, because

- it is unlikely that the indifference curves between any two characteristics will be of the shape assumed in REM theory, the one shown in Figure 1,
- a great many other, complex, curves certainly exist for important characteristics of common goods,
- the threat of contamination means that all goods have some indifference curves like that shown in Figure 8.

Since the REM theory cannot reach any of its conclusions unless *all possible indifference curves* conform to the fundamental assumptions, it cannot describe reality.

Fundamental Assumptions on Characteristics Space

A fatal logical error runs through discussions of fundamental assumptions in REM theories, and in the logical framework built from these discussions. The curves in REM theory are plotted in a single ‘characteristics space’ with axes in the form ‘[Level of] characteristic A’ and ‘[Level of] characteristic B’. All curves are plotted in this space and all analysis is in this space.

This is invalid. One’s preference surface for curry powder, for instance, can be plotted in a number of different characteristics spaces, and can be expected to produce different shaped indifference curves in each. The space might refer to the level of characteristic in one’s stew, the level of characteristic in one’s ice cream, the level of the characteristic in a single meal, the level of characteristic in one’s diet or the level of the characteristic in total consumption (and, while much of REM theory is concerned with level of characteristic in total consumption, it is difficult to believe that most individuals have a concept of, or a preference for, the quantity of curry powder, or most other characteristics, in total consumption). Figures 8a and 8b show one individual’s preference curves for two characteristics in two products, showing how the shapes change when they are plotted in different characteristics spaces.

This error has serious consequences for the theoretical analysis. Lancaster, for example, uses at least a dozen different spaces interchangeably, without realising that moving from one to another usually implies a change in the shape of indifference curves and price curves. Some spaces he uses are:

1. Total amount of characteristic in total consumption.
2. Total amount of characteristic in diet (1971 p17).
3. Total amount of characteristic in one unit of a good, an automobile (1971 pp157-174).

4. 'Cleaning power per dollar' for detergent (1966 p153).
5. Level of characteristic obtained from one or more goods within a group of goods, but not obtained from other goods. (especially 1971 pp 125-139)
6. Characteristics per unit of a good (1979 p28).
7. A 'normalized' characteristic, defined such that all consumers have the same efficiency frontier - his second paradigm case. This may however be built on any of the above - characteristics in total consumption, an automobile, unit quantity of a good etc. While Lancaster does attempt to present 'normalized' curves in the 'characteristics in total consumption' space, most of his followers present identical diagrams in an explicitly different space '[normalized] level of characteristic [in total consumption] per dollar'. The conversion of the analysis to the second paradigm case of 'normalized' preference and supply is only possible when the boundary assumptions of linearity, additivity, perfect knowledge, etc. apply (see below). No consideration has been given by anyone to the problems of 'normalizing' curves in the other characteristics spaces mentioned.

Fundamental assumptions on supply

REM theories also make assumptions on supply which are fundamental, as one cannot proceed to the first stage of the analysis, determining a consumer's optimum purchase, without them. The theories require that *all* supply functions for all characteristics facing the individual consumer are of the form assumed. It will be shown here that few products have all or even most supply functions which fit the assumptions. This, taken with the inapplicability of fundamental assumptions on demand, and the logical errors associated with them, makes it doubtful whether there are any situations for which the assumptions are even a very rough approximation

The fundamental assumptions of REM theory on supply mirror the assumptions on consumer preferences. It is assumed that at equilibrium one can only get a characteristics mix with more of any one characteristic by paying more. In general, all characteristics are taken to be positively priced. In traditional analysis based on separate *goods*, it was assumed, quite reasonably, that it was always possible to obtain more of a good by paying more and that all goods were positively priced, as in REM theories. It is far from clear that the same applies to the *characteristics* of a good.

The REM supply assumption requires that market level price is not influenced by consumer preferences. For example, it requires that market prices for wine increase with the level of acid and sugar, and that extremely acid, extremely sweet wines get the highest price. Figure 9, however, shows what may be observed in a shop. The constant outlay contours for a bottle of white wine are highest around a medium-sweet, medium-acid wine, as market demand is concentrated on these. The very acid,

very sweet wines and the bland ones are on lower constant outlay curves. This shows a common supply price situation, a bull's eye, which is very different to REM assumptions.² Superimposed on this is the indifference surface of one individual who prefers a slightly sweeter, more acid wine than the average. His or her choice will clearly be a point where both constant outlay curve and indifference curve are *concave* to the origin, and there will be a trade off between quantity and quality. This is contrary to the fundamental assumptions of REM. In the REM theories the consumer maximizes utility by buying as much cheap, very acid, very sweet, wine as possible, which is clearly contrary to fact.

In price taking markets, price is strongly influenced by aggregate demand in the short run, and preferences like those shown in Figures 2 to 8 will produce supply functions facing the individual consumer which are very different from the REM assumptions.

In price making markets, producers may set prices in such a way that goods with higher levels of a characteristic cost more. This is only likely to be the case for goods such as those produced by mixing ingredients, where there is a clear relationship between the level of characteristic and the cost of production. However, price making markets cannot exist under the other assumptions of REM, that all buyers perceive the same levels of the same objective characteristics for instance.

It is clear from Figure 9 that it is not possible to plot an individual's multidimensional indifference surface in such cases by observing purchases. A very large number of observations would be needed, with all other factors remaining constant -- price, availability, availability and price of other goods etc. In practice few people buy any good so often that even a dozen purchases are directly comparable, with all other factors constant, and a dozen observations are inadequate to plot even a two-dimensional indifference curve.

Fundamental assumptions on subjective or objective quality

The major advantage claimed for REM theories of quality by its inventors is that they permit analysis based totally on objective quality characteristics, without going into psychology, subjective perceptions etc. Most REM theories are based on the assumptions that a) a good has objective characteristics on which individual consumers base their choices, b) that all individuals see the same characteristics and perceive them identically but c) they may value these characteristics differently. They explicitly ignore subjective attributes and even non-measurable characteristics.³ (Lancaster, 1979 p18)⁴

² Where there are significant economies of scale in production, the price may be lower at the centre of the bull's eye. This may also arise with economies of scale in distribution with delicatessens and health food shops charging more for items that do not have sufficient sales to be stocked in supermarkets.

³ 'The characteristics which appear in the analysis are assumed to be objectively quantifiable, as well as objectively identifiable, even though there are important characteristics (color for example) that do not fit this specification. Although color can be objectively defined by primary color composition and degree of saturation, color differences cannot be put on a simple scale like size or

The whole of market economics and marketing as well as much of mainstream economics, including the theory of monopolistic competition, the economics of information and the economics of advertising, rejects these fundamental assumptions.

One approach based on totally different assumptions is to argue that quality is in the mind of the consumer, and that a consumer values a good purely for those qualities he or she attributes to it. Choices are made on these attributes, never on characteristics. The attributes may have no relation to any objective characteristics, and if they do, the relationship is seldom simple, as it may be influenced by advertising, brand image etc. If the consumers can see characteristics, they may or may not use them as a cue or proxy for attributes. Much of the theory of quality used in marketing is consistent with this approach.

Hedonic theory too is generally based on a completely different set of fundamental assumptions. One possible formulation is ‘In this market there are goods with more of what I, the researcher, subjectively perceive to be the objective characteristics A, B and C. Regressions show that these get a higher price. I hypothesize that if the marginal producer switches to a product with more of these characteristics, he or she will get a higher price.’ This does not require that the consumers’ decisions are made on characteristics, but rather that the objective characteristics are cues for the attributes on which decisions are made. Another possible formulation is ‘Market research has been done which attempts to identify the subjective attributes which most individuals ascribe to goods in this group, and the level of attribute they ascribe to each. It is hypothesized that those goods with the highest level of attributes X, Y and Z ascribed to them will get the highest price. It is further hypothesized that if the marginal producer increases these attributes for his or her product, whether by advertising or by changed product specifications, he or she will get a higher price’⁵ In this common formulation, the objective characteristics will not come into the analysis at all.

In view of the fact that so much of economics and marketing uses subjective attributes, it must be asked what would happen to REM theories if subjective attributes were used instead of characteristics. Lancaster is under no illusions:

horsepower or vitamin C content so that everyone agrees that good A has twice as much per pound as good B.’

⁴ (Lancaster, 1979 p18)

⁵ The subjective attribute may be linearly related to preferences even where the characteristics on which it is based are not. Nevertheless, the previous sections have shown how easily specification errors can arise.

‘If different individuals were to “see” the same goods in fundamentally different ways, there would be little point in devising an analysis to take account of the objective properties of goods. For then either it is meaningless to speak of “objective” properties, or those properties which are objective are irrelevant to people’s relationship to goods.’ (Lancaster, 1971 p6).

Some of the problems that can arise are as follows:

The first limitation is that the REM approach demands that all individuals’ preferences and supply can be plotted on the same set of axes, and that all face the same supply. The analysis cannot begin if different individuals cannot plot a given good on the same set of axes. If some people perceive non-existent characteristics, like the dietary fibre content of beef, ignore ‘objectively important’ characteristics like the monosodium glutamate content of junk food, or just perceive different attributes as important, judging a suit by whether it is ‘well cut’, ‘fashionable’, ‘suitable for the office’, ‘flattering to my figure’, ‘sexy’ etc., then neither the preferences nor the supply function can be plotted within the same set of axes.

Another limitation is that individuals must perceive and measure these same characteristics in identical terms if their preferences and supply function are to be plotted in the same space - even if there is perfect knowledge. Individuals with perfect knowledge of a car engine’s power, for example, might perceive it in terms of Brake Horse Power, cubic capacity, top speed, acceleration at cruising speed, acceleration from a red light or ability to pull a trailer.

Further limitations arise because subjectivity implies that individuals do not perceive characteristics correctly. An individual could, conceivably, plot his or her own indifference surface against axes like ‘My perception of level of characteristic A’ but this indifference surface could not be moved into a diagram with axes like ‘Mrs Y’s perception of the level of Characteristic A’. One brand could be in a different position in each preference map, and the budget curves and price line certainly would be. In addition, such curves would ignore the strength of belief about the level of characteristic and the associated risks, which are important in the economics of information and decision theory. If an economist or market researcher were to plot other people’s self-described indifference surfaces against his or her own perceptions of level of characteristic, the shape of the preference and supply functions would change. Even if an individual’s preference and choice conformed to REM assumptions in the light of their own perceptions, it is unlikely that this would still be the case when they were plotted in the light of the researcher’s perceptions, particularly with branded goods.

The special attraction of REM characteristics approaches to quality is claimed to be that, unlike the attributes approaches, which take perception, belief and so on into account, it predicts the changes in sales that can be expected from changes in a good's objective characteristics (a change in production specifications for instance). This does, however, mean ignoring the fact that sales can change while characteristics remain constant, or vice versa, because of changes in attributes arising from advertising, availability, information, guarantees, location, and so on, as several branches of mainstream economics attest.

Lancaster was right. If subjectivity is allowed to enter REM analysis, it collapses. It is no longer possible to reach the paradigm case where the decisions of several individuals can be directly compared on the same diagram and they have the same supply function plotted on the same diagram. Since most economists, including most working with REM approaches, find it difficult to work without bringing in subjectivity, this must have the effect of limiting the application of REM theory to a small part of reality, those situations where consumer behaviour depends entirely on objectively measurable characteristics.

BOUNDARY ASSUMPTIONS

The fundamental assumptions are intended to apply to all individuals and all products. However, any economic theory is developed to cover a smaller domain, one defined by its boundary assumptions. These are seldom spelt out explicitly and rigorously, so the example used here is that of Lancaster (1966, 1971, 1975) because his boundary assumptions have been set out rigorously and explicitly and have been discussed in the literature, because his theory continues to be the dominant economic approach, and because his original presentations remain to this day the paradigm cases for the theory, a remarkable achievement. He assumes inter alia that

- a) the satisfaction obtained from a characteristic is independent of the good in which it is supplied or consumed, so one gram of sugar gives the same utility, whether it is in wine or ice cream or curry.
- b) Any goods can be consumed jointly and it is the total level of the characteristics in total consumption from the combination that determines the satisfaction gained, not the level in any one good.

None of his optimization and aggregation procedures apply where these assumptions do not hold. These assumptions are wrong if they are self contradictory or if, as he admits (1979) is true of the assumptions of his 1975 paper, they rule out all reality.

These assumptions are highly restrictive, and largely restrict application of his version of REM theory to situations similar to the agricultural economist's least-cost chicken

food problem (from which Lancaster's theory evolved). It cannot legitimately be used for other products. There have been powerful criticisms of his theory on the grounds of over-restrictive boundary assumptions by Hendler (1975), Ladd and Zober (1977) and Lucas (1975), but, interestingly, these have been cited by only 1.5 per cent of people who cited Lancaster's work in recent years.

AD HOC ASSUMPTIONS

Ad hoc assumptions are made because the theory will not work with just the boundary and fundamental assumptions (see Popper 1972 pp 15-16, 30; 1976 pp 40, 42). Typically they introduce a new constraint or assume a mathematically convenient function. They are not to be confused with realistic assumptions introduced to turn a simplified theory into a situation-specific model. Each *ad hoc* assumption introduces new limits to the area of application of the theory, so a large number of *ad hoc* assumptions implies that the theory will have little or no application. Each explicit assumption also introduces an unknown number of implicit assumptions, so the more assumptions there are, the more likely it is that the assumptions will be contradictory or rule out all of reality.

Most writers on REM theories of quality leave many of their *ad hoc* assumptions implicit, and it appears to be normal to borrow the analysis of a previous writer without mentioning the *ad hoc* assumptions he or she was careful to make explicit. For this reason the example of Lancaster is taken again: he was scrupulous in making his assumptions explicit, and his many followers seldom mention the *ad hoc* assumptions that were essential to the analysis they take from him. There are some 63 explicit assumptions in *Consumer Demand* (1971), at least 40 of which must be classified as *ad hoc* so there is virtually no chance that the theory has any practical application. Some such assumptions are:

- When one is dealing with a group of closely related goods, all other goods may be treated as equally close substitutes for this group (Lancaster 1971 pp128-9). [He uses "goods" in the sense of a single product line.]
- There is a uniform distribution of income so that average income is constant over preferences and there is a rectangular distribution of preferences, with constant density taken to be unity (Lancaster 1971 p79).
- The consumption technology is linear, after ignoring invariant characteristics, and a characteristic is irrelevant if there is a linear dependence in the technology (Lancaster 1971 p142).

- "The most heroic assumption is the *uniformity assumption* on the nature and distribution of preferences". "In geometric terms it implies that the transformed indifference curves in specification-quantity space are all of identical shape and are tangent to the [Product Differentiation Curve] at the specification corresponding to the most-preferred good" (Lancaster, 1979, p.47).

Many of the remaining assumptions are *ceteris paribus*. The *ceteris paribus* assumption is a powerful analytical tool at some stages of an analysis, but if these assumptions are not eventually dropped they are just *ad hoc* assumptions, or possibly boundary assumptions, in another guise. Lancaster does not drop them.

There is no conceivable way in which one could determine if any individual had preferences that matched these assumptions, so they are, in essence, no different from assumptions about how many angels can dance on the end of a pin.

It is extraordinary that, in view of these limitations, Lancaster should have drawn from these assumptions broad generalizations on 'welfare, variety and the GNP', 'intra-industry trade between identical economies', 'variety in capital goods', 'the optimal division of labour', and 'variety and economic development' in the final chapters of *Variety, Welfare and Efficiency* (1979).

Two-Stage Models

In Lancaster (1966) a two stage model was presented, which was abandoned as unworkable in his later work, that characteristics are derived from consumption activities in which goods, singly or in combination, are the inputs. This makes the above assumptions infinitely more restrictive. It requires, for instance, that all consumers should still perceive the same output characteristics identically when a set of meals is cooked from a given market basket, whatever the meals are, whoever cooks them.

HEDONIC PRICES

This section discusses the meaning of hedonic prices in the light of the discussion and Figure 9.⁶ Market-level hedonic analysis dates back to Waugh (1928) and was derived from market level analysis. It predates REM theories of quality and is logically independent of them. Rosen (1974) is primarily an attempt to justify the

⁶ "Hedonic prices are defined as the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amount of characteristics associated with them ... Econometrically, implicit prices are estimated by the first-step regression analysis (product price regressed on characteristics) in the construction of hedonic price indexes". (Rosen, 1974, p.34).

analysis from a REM viewpoint and Lancaster (1966, 1971) is often interpreted in the same way (e.g. by Earl, 1986 and Steenkamp 1989).⁷

These attempts fail because, apart from the other failings of REM theory, the hedonic price is not the price used in REM theory. An individual consumer in REM does not make choices on the basis of regressions: he or she makes a choice on the basis of the prices and characteristics of all products on offer. What is required for this analysis is a price list valid at the instant the decision is made. This is quite different to the prices produced from a regression based on observed transactions, which gives little weight to prices at which there were few transactions and none to those possibilities that were considered, then rejected, even though all were valid options to the marginal buyer.⁸

Some misleading results of using regressions instead of a price list are shown in Figure 9. Here the regression curve would indicate negative prices for both characteristics if most observations were in the NW quadrant and positive prices for both characteristics if most observations were in the SE quadrant. If most observations were in the NE or SW one characteristic would appear to be positively priced, one negatively. If the observations were scattered randomly, a linear regression would give a poor fit. These results all occur in a case where there is a clear, logical and consistent relationship between price and level of characteristic.

It may be asked why a consumer with a price list would wish to know the price of each characteristic. The process of first ranking alternative goods by their characteristics (or attributes) then by the price of the goods (not the characteristics) then selecting, is infinitely easier than running a regression, then a linear programme, before making the optimum choice and it seems to be what people do, according to market research.

Since REM theories and hedonic theory are dealing with different types of price, REM theories can neither support nor detract from hedonic analysis.

CAN THE THEORIES BE TESTED?

⁷ Rosen's fundamental assumptions are close to Lancaster's, though the analysis develops in a different direction.

⁸ The REM analysis is confusing: Rosen (1974) appears to assume that the set of prices facing buyers is at the same time:

- a market clearing price,
- an average equilibrium price at the end of a day's trading
- the price facing each buyer and each seller at all periods through the day.

Economic theories are generally presented in a form which does not apply to a specific real world situation, so they are not directly testable against the real world. However, the main output of economists is situation-specific models of the real world, constructed from a range of economic theories and logic appropriate to the situation: data can be fed into these to produce predictions. It appears at first sight that a theory can be tested indirectly: if models making use of Theory X are generally poor predictors, and models making use of Theory Y are good predictors, then in some sense Theory X has been tested and found wanting.

Such a test is possible *if and only if* one can say unequivocally that the assumptions of the theory hold in a given situation. In the absence of such information, no number of poor predictions would be conclusive evidence that the theory was a poor predictor: they could equally be taken as evidence that the assumptions of the theory did not apply in that particular case. It is not usually considered a criticism of a theory that it does not perform well outside the domain of its boundary assumptions for instance.

With the REM theories there is a strong presumption that the assumptions do not hold, that indifference curves have a completely different shape to that assumed. It is not possible to plot an individual's indifference curve with regard to characteristics (not attributes), much less the indifference curves of most of the population being considered. It is not possible to ascertain that the *ad hoc* assumptions hold, though it may be easy to ascertain that some do not. It is no different from saying that the theory works when six angels are dancing on the end of a pin, but not when only five are.

This means that it is not possible to say whether a poor prediction arose because the assumptions were wrong for the situation, or a good prediction arose in spite of the assumptions being counter to the facts of the situation. The theory cannot be tested.

TESTING REM THEORIES BY THEIR PREDICTIONS

Under some of the epistemologies discussed below, the only justification for using any of the REM theories would be that its predictions have been tested frequently and found to be consistently good (i.e. verified) or have been crucially tested and not falsified. The fact that their assumptions do not apply is irrelevant. The number of tests required is greater if the theory is taken as a tendency rather than as a general law.

In spite of extensive literature searches, I am not aware of any attempt at a programme of tests of this sort, for any one of the REM theories of quality or their variants. Since these tests are difficult, time consuming and expensive, it would be prohibitively expensive to carry them out. Even if there had been such a programme, it is doubtful

if it would have overcome the problems of testing identified by the Victorians,⁹ Hutchison (1938), Machlup (1963) and "sophisticated falsificationists" (Popper himself being one), all of whom have given reasons why we can ignore a large number of predictive failures and successes.

The vast majority of analyses have been carried out not as tests of the theory, but to help make a better decision in a specific instance. They have not been designed as tests of the theory, and they cannot be interpreted as tests. The situations examined are in no sense "typical" and have not been derived from a stochastic sample from a known population, nor are all the models reported - under reporting of unsuccessful predictions can be expected - so it is not possible to "trawl" the literature to find out which theories most often produce models which are good predictors.

Many of the models do not in fact use the theory they claim to use, so their results are grossly misleading in this respect. Many claiming to use Lancaster or Rosen are in fact using the mainstream hedonic theory deriving from Waugh. Lancaster complains of this (1971 pp113-4), but the problem remains to the present day (see, for example, Larue, 1991; Williams, 1991; McDaniels, Kamlet and Fischer, 1992; Ortono and Scacciati, 1992; Thomas, 1993; Berliant and Raa 1991; Thomas 1993; Johnson and Fornell, 1987; Heffernan, 1990.)

The few attempts at tests have been hampered by lack of resources. For example three models have been compared for one particular situation at one moment in time, but not for a range of situations over time. There has been no attempt at large scale testing, designed specifically to test competing theories.

HOW SERIOUS ARE THESE WEAKNESSES?

How serious are the weaknesses identified so far? As economists are not agreed on grounds for rejecting theories, the force of these criticisms will be looked at here from a range of epistemological standpoints. The criticisms may be summarized as follows:

Fundamental assumptions

- A. The fundamental assumptions on consumer preference are counter to observed reality - they are in no sense simplifications. It is extremely unlikely that any individual will have preferences like those assumed for any product group.

⁹ "The ingenuity of these nineteenth century writers knew no bounds when it came to giving reasons for ignoring apparent refutations of an economic prediction, but no grounds, empirical or otherwise, were ever stated in terms of which one might reject a particular theory" Blaug (1980) p 55.

- B. Confusions about the fundamental assumptions on characteristics space have caused logical errors which permeate the theory.
- C. The fundamental assumptions on supply price are contrary to observed fact in many cases. They are only likely to be approximated in price-making markets where other REM assumptions cannot apply. There is confusion as to which price is appropriate.
- D. The fundamental assumptions on objectivity of characteristics are crucial to the analysis, but they exclude factors most economists think important.

Boundary Assumptions

- E. Boundary assumptions are very restrictive

Ad hoc Assumptions

- F. The *ad hoc* assumptions remove all possibility that the assumptions apply for any individual.

Do the assumptions apply?

- G. It is not possible to determine that the assumptions apply in any situation, though it may be easy to show that some do not: it is not possible to plot a multidimensional indifference surface from observed behaviour or to determine whether most of the *ad hoc* assumptions apply. It is extremely difficult to determine the prices facing an individual, and there are enormous difficulties with self explicated indifference curves. If the predictions of a model are wrong, it may or may not be because the assumptions do not hold in that instance.

Has the theory been tested?

- H. There has been no rigorous testing by predictions, based on a series of carefully designed crucial tests.

Nearly all economists believe that there is some virtue in a theory that argues logically from explicit assumptions. There is no other justification for the vast majority of the economic literature, and no other justification for the carefully specified assumptions and logic of REM theory. To these economists the logical errors of the REM theory are fatal.

Most economists believe that there is a virtue in working from what we know, realistic assumptions, to what we do not know, rather than from what we know to be contrary to fact. They may also believe that if they work from patently false assumptions, non-economists will not believe them and they will lose their jobs. To

them the REM theory must be rejected because the assumptions conflict with reality. Some economists, however, believe that the realism of assumptions is irrelevant or even that unrealistic assumptions are to be preferred.

It is instructive to look at the epistemological stances underlying these positions, though they are seldom made explicit, and there is a great deal of confusion. Some positions are:

Theory as logic.

The epistemological stance of most practitioners is that theory is a string of logic. The practitioner will take some strings of logic from different areas of economic theory and “cut and paste” to create a model of a specific market. In much the same way, engineers apply mathematics to make models of bridges. There is no presumption that the theory describes the truth, only that it is logically correct. There is an infinite number of possible logical theories and practitioners select ones which

- are logically correct,
- have assumptions which approximate to the reality of the market being modelled,
- are “easy to use” or subjectively pleasing, factors which fall outside the scope of this paper.

Under this epistemology, models are expected to describe the truth, and are testable on their logic, their predictions and the realism of their assumptions.

REM quality theory will be rejected under this epistemology on the grounds of assumptions contrary to fact and incorrect logic. Models making use of it will also be rejected by Popperians as “unscientific” on the grounds that it is not possible to determine that the assumptions apply in any specific instance, so they cannot be tested.

Theory as truth.

These epistemological positions are that theory, whether economics, marketing or consumer behaviour, bears much the same relation to the truth as the physical sciences do. This truth can be discovered by observation and written down as a general law. There is only one truth. This theory must have assumptions which correspond to reality, and must be logically correct, so REM quality theory can be rejected on these grounds.

Models making use of these theories may be tested by their logic, their predictions and the realism of their assumptions. Since REM theory fails on logic and realism of assumptions, it cannot be used under these epistemologies. In principle, since there is a single truth and the assumptions always apply, the failure of a prediction in one instance could refute the theory (subject to the caveats above), so the theory is scientific in Popper's sense.

Theory as probability.

Theory is truth, but only in those situations where the assumptions of the theory apply. It is probable, usual, normal, common, or possible that the assumptions apply in real life situations.

These epistemologies can be used in much the same way as "theory as logic". First a situation is identified where the assumptions apply, then a model is constructed, a model which can be tested by assumptions, logic or predictions.

Alternatively, the theory may be applied to situations where the realism of the assumptions is not known, in the belief that it will "probably" apply. The implication is that in day to day situations it is very easy to test models by their predictions, and very difficult to determine whether their assumptions are realistic. Formally, such models can be tested by their assumptions and their logic, as well as their predictions. For this approach to be workable, the users must have some concept of the degree of probability and the type of situation where the degree of probability is high (in effect, the type of situation in which the assumptions are realistic.) This requires carefully replicated tests of the predictions made by models, with stochastic sampling from carefully defined parent populations to chose situations to model. The number of replications needed rises as the probability falls. Further increases in the number of replications are required when it is accepted that there are many reasons, discussed above, why a good theory might be a bad predictor in any instance. This has not been attempted with REM quality theory.

These epistemological approaches would reject REM quality theory for its assumptions conflicting with reality and for logical errors. In addition the fact that no attempt has been made to determine the probability that it applies in any instance invalidates one possible use.

"As if" theory

One set of epistemological approaches goes "Of course people do not behave like rational economic man. However, in the aggregate they do, so we can use REM theories as if they were true."¹⁰ Possibly an unusual interpretation of

¹⁰ These epistemologies may be linked to methodological approaches like those of Mises (1949), Menger, Robbins (1935), Knight (1940, 1941), Machlup (1963) or Friedman (1953) which argue that the testing or verification of assumptions is unnecessary or undesirable. One school of thought

Friedman (1953).¹¹ At one level this may be saying no more than at market level, more is bought when prices fall, even though many individuals do not change their purchases. At another level, the much more complex REM quality theories are taken to have general application in the aggregate, even when they pay virtually no attention to the problems of aggregation. This is far less credible, so more justification is needed.

Models constructed from such theory can only be tested by their predictions, as their assumptions are taken to be irrelevant. Logic, too, appears to be irrelevant, though if this is so, it is not clear why REM theorists should present their careful logic.

There is an infinite number of possible theories based on unrealistic assumptions, and many will, by chance, predict correctly from time to time. How does one decide which to use? A process like the screening of new chemical compounds for their use as drugs would seem appropriate (without however the scientist's knowledge that certain types of compound are likely to be effective). This requires a very large number of carefully replicated trials, comparing a wide range of possibilities. This has not been attempted, so there is little corroboration for any of the REM theories or their variants. If the "as if" theory is taken as being universally applicable, it would take only a few predictive failures to refute it, and there have been many apparent predictive failures.

Even if one variant of the theory had been tested in this way, it would give no credibility to other closely related theories which share many of the fundamental assumptions. Differences in the fundamental assumptions, boundary assumptions, *ad hoc* assumptions and logic make them different. In the other epistemologies where the theory or the model is intended to correspond to the truth, anything logically derived from them also corresponds to the truth, and anything logically derived from them with the addition of realistic assumptions also corresponds to the truth. With the 'as if' epistemology this is not so: one formulation may be a good predictor, while something logically derived from it may be a bad predictor; a theory which is a good predictor when based on unrealistic assumptions is likely to be a bad predictor when new assumptions, realistic or unrealistic, are introduced.

In fact, very few theoreticians would argue that their "as if" theory is universally applicable, and there is no surprise that many models using it do not predict well.

is that theories based on unrealistic assumptions, not simplified assumptions, is actually to be preferred (e.g. Trail, 1995, Sternthal, 1995).

¹¹ This appears to be based on an unusual interpretation of Friedman.

“Probably as if”

Some epistemologies have the less extreme formulation that consumers in aggregate probably, often, sometimes, or occasionally act as if X was the case, even though it is accepted that X is not the case. To some degree it is probable that in any (randomly chosen?) situation, theory X will be a good predictor. Again, there is an infinite number of possible theories based on unrealistic assumptions, and no possible way of selecting them except by their predictions. Again, a great many tests would be necessary to identify theories which were good predictors, and these would have to be based on stochastic sampling from a carefully defined parent population if anything more was to be said than “This theory gives accurate predictions when it gives accurate predictions, but not otherwise”. However the fact that the theory is not meant to work in all situations means that far more tests have to be carried out, and they have to be replicated. This would be extremely time consuming and costly. No attempt has been made at such tests of REM theories of quality, so there is nothing to distinguish them from an infinite number of theories including ones based on astrology.

Models based on the REM theory of quality have no corroboration at all until they have made predictions and have been shown to be accurate. For most economic decisions such a procedure is impossible or impracticable. Under the first three sets of epistemologies set out above, the practitioner can apply theory or logic to observed facts to make a prediction and can have some grounds for believing it will be correct. It is not necessary that its predictions have been tested before one can have any grounds for belief in it.

Conclusion

It is concluded that under all the commonest epistemologies of economics, and some of the more idiosyncratic approaches, the REM theories are refuted.

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