A REFUTATION OF THE CHARACTERISTICS THEORY OF QUALITY

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ABSTRACT

This is a formal refutation of the characteristics approach to the economics of quality, which is particularly associated with Kelvin Lancaster. Many of the criticisms apply equally to other approaches to the economics of quality.

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Lancaster's theory of Consumer Demand is the dominant theory of the economics of quality and it is important in marketing. Most other approaches share some of its components. Like most economic theory this makes no testable predictions. Indirect tests of situation-specific models using the theory are impossible, as one cannot identify situations where the assumptions hold. Even if it were possible, it would be impracticable. The theory must be tested on its assumptions and logic.

The boundary assumptions restrict application to very few real life situations. The progression of the theory beyond the basic paradigm cases requires restricting and unlikely ad hoc assumptions; it is unlikely in the extreme that such situations exist.

All the theory depends on fundamental assumptions on preferences, supply and characteristics. An alternative approach is presented, and it is shown that Lancaster's assumptions, far from being a reasonable approximation to reality, are an extremely unlikely special case. Problems also arise with the basic assumptions on the objectivity of characteristics.

A fundamental logical error occurring throughout the theory is the failure to recognize that the shape of preference and budget functions for a good or characteristic will vary depending on whether a consumer values a characteristic according to the level in a single mouthful, in a single course, in a meal, in the diet as a whole or in total consumption, for instance.

Many of the criticisms raised apply strongly to other approaches to quality. The alternative approaches developed here, to preferences, prices and different characteristics and goods spaces, can fit into some other approaches to quality. They permit more accurate and more realistic specification of models.

The criticisms are original, apart from some previous criticisms of over-restrictive boundary assumptions in Lancaster. The alternatives presented are new.

THE IMPORTANCE OF QUALITY

Quality plays a role in most transactions. It is an important determinant of prices. Today, quality is one of the main elements in competition. Both firms and nations compete not just on price but on their ability to produce good quality products and services. The importance of this in the USA and Britain has been shown by Wong, Saunders & Doyle (1988), Garvin (1988), Ouchi (1981) and Jacobson & Aaker (1987). In the food industry it has been particularly noticeable that the supermarket chains which survived the cut-throat competition of the last 25 years have been those that gained a reputation for quality, particularly in fresh foods, rather than those that aimed at low prices. This has had profound effects on the farming industry, on competition within the sector and on what people eat.

THE OBJECTIVE OF THIS REFUTATION

This refutation sets out two closely related hypotheses to be tested:

1.   Lancaster's characteristics approach to the economics of quality is correct.
2.   Lancaster's characteristics approach to the economics of quality is useful in the economics of the real world.

The expected outcomes of the testing procedure are one of the following:

-       The theory survives unscathed, and as a result we can have more confidence in it.

-       The theory survives unscathed, being internally consistent, but is shown to have little or no practical application within real-world economics, and must be discarded.

-       The theory is shown to be weak in some aspects, but to survive the testing elsewhere. In this case the value of the theory is increased by recognizing and removing the weaknesses. It may be possible to repair the damage with new theory for instance.

-       The theory is shown to have limited application within real-world economics, but to survive testing within that application. The value of the theory is increased by recognizing this limitation, and not attempting to apply the theory where it has no application.

-           The theory is logically incorrect, and must be regarded as refuted.

In the remainder of this chapter first the justification for testing Lancaster's theory is explained then the methodology for testing the theory is set out.

LANCASTER'S THEORY OF QUALITY

It is difficult for anyone working on the economics of quality to ignore Lancaster's theory of quality in consumer demand. It is probably the most influential theory of consumer choice of quality in the economic literature and it is also very influential in marketing. It is the most cited theory in the literature - over 1500 citations - and has reached that stage where it is used without being cited. It is used in applications relating to a wide range of goods and services. The theory was presented in two papers and two books (Lancaster 1966, 1971, 1975, 1979).[1]

The basic assumptions and logic are shared to a greater or smaller extent by other economic approaches to quality, and most other approaches share some aspects of the theory. This means that any weaknesses or limitations identified in Lancaster's theory have implications elsewhere.

The theory is probably the most rigorous and the most fully presented of the economic approaches. That is to say he is less likely to omit important assumptions and distinctions than other economists. It also means that his theory is harder to attack.

The theory is based on economic man. It builds up from assumptions about individual consumers to conclusions about market supply and demand, rather than being either based on empirical findings about individuals or operating at market level only. Its fundamental assumptions are to do with:
1)   the nature of preferences: it is assumed for example that the indifference curves for characteristics have the properties of the familiar indifference curves for goods,
2)   the nature of supply: it is assumed that the consumer has to pay more to get

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[1]   **Lancaster, K.J.** "A new approach to consumer theory", Journal of Political Economy, 74, 132-157. 1966.
        Lancaster, K.J. Consumer demand : a new approach. New York. 1971.
        Lancaster, K.J. "Socially optimal product differentiation", American Economic Review. [September] 99-122. 1975.
        Lancaster, K.J. Variety, equity and efficiency. Columbia studies in Economics No. 10. New York and Guildford. Columbia University Press. 1979.

3)   more of a characteristic and that he or she can get more by paying more,
3)   the nature of quality: it is assumed that quality is in the mind of the consumer, that individuals see the same objective characteristics in a good, but value them differently.

Lancaster's theory provides a "construct paradigm", in Masterman's (1970, p.65) classification of Kuhn's (1962) twenty-one uses of the word paradigm. That is to say it may be seen as an actual textbook or classic work, as supplying tools, or as actual instrumentation. The paradigm he provided has not been altered or replaced by a better form in the same tradition, though of course many completely different theories have been presented. It is unusual for a paradigm to survive unmodified for so long (see Kuhn, 1962 p.10), without being replaced by an improved, richer form, and this is an indication of the quality of Lancaster's presentation.

Lancaster's popularity appears to derive from the following:
1)   The analysis is presented rigorously, based on assumptions which are usually made explicit. This analysis is set out at some length.
2)   The theory is presented clearly.
3)   Lancaster shows his integrity by pointing out limitations in his theory and making explicit assumptions where he feels it necessary.
4)   The theory uses objective characteristics rather than perceptions and beliefs. This gives the promise of "hard" results. It is also very much cheaper to work with easily measured characteristics than it is to identify and measure consumer perceptions.
5)   The theory has a strong resemblance to economic theory which has proved successful elsewhere, like linear programming for least cost diets. It also makes use of familiar theory, on indifference curves for instance.

Lancaster's approach is one of several with a close family resemblance. Theories presented by Becker (1965), Muth (1966), Ironmonger (1972) and Gorman (1956/1976) are also so close that they are generally treated as the same theory in so far as they deal with quality. Other theories such as those of Rosen (1974), Houthakker (1952), Thiel (1952) or Ladd and Zober (1977, 1979) share many of the same basic assumptions. These are discussed in detail in Chapter Four.

THE REAL-WORLD ECONOMICS APPROACH

The refutation will examine Lancaster's theory from the perspective of real-world economics. The most important requirement of real-world economics is that any theory it uses has to be operationally usable in the economic analysis of real-world production and marketing. Some theory which would be acceptable elsewhere is clearly inappropriate or largely irrelevant in real-world economics. This unacceptable theory includes economic analysis that is based on assumptions clearly

irrelevant to real world problems, and economic analysis that is excellent for analysing other markets, but is largely irrelevant to agriculture.

Agricultural products tend to be more variable than industrial products, so uniformity is achieved by classification and sorting, rather than by tight control over process and quality assurance. Agricultural production tends to produce a product of variable quality, and generally no extra expenditure on production or attention to detail will produce a single quality of product of the uniformity that is expected as a matter of course in most manufacturing. Uniformity is achieved by sorting and classification more than by changed production systems, so these tend to be given more emphasis than in studies of industrial products. Branding is less common and less powerful than in many other markets. The products are seldom durables, and the study of the quality of durables in agriculture has largely been confined to studies of tractor prices. Service quality is not of key importance, though it may not be possible to ignore its effects at retail entirely. Most agricultural products are fast-moving consumer goods at retail. Some are highly perishable.

The models developed in real-world economics must be realistic for two reasons. First, unrealistic models are unlikely to produce realistic predictions in complex markets. Second, the people who make the decisions in the sector are usually unable to assess the competence of a theoretical economic analysis, but they can and will reject a model on the grounds that its assumptions are unrealistic, even if, in the economist's view, some of the simplifications made are quite justified. An agriculturist may feel perfectly justified in rejecting an economic model that assumes that there is no difference between the demands for different types of meat, or their supply, for instance

METHODOLOGY

There are several reasons why Lancaster's theory should be tested. First, this theory and other theories with a family resemblance dominate economics approaches to quality and are influential in marketing, so they are clearly worth testing.

Second, the fact that a theory is widely used does not indicate that it is correct - the flat earth theory was dominant at one time, and remains the theory that is used for measuring a football pitch or planning a city. One can only have confidence in theory which has been tested repeatedly and has survived that theory. Lancaster's theory has not been tested in this way (and there has been little attempt to test other theories). There have been a handful of critical papers, which will be discussed in Chapter Four, which made valid criticisms of the boundary assumptions, but these criticisms have not proved powerful enough to make the theory unfashionable. There have been no crucial tests of the theory. This dearth of previous testing means that if the theory is subjected to rigorous testing here and it survives, there will be a

significant increase in the confidence we can have in it - even if other people might have chosen to test it in other ways.

Thirdly, there is already an embarrassingly large number of competing theories, in a subject that has developed in the past sixty-six years. As the present generation of economists reaches maturity, we can expect a great many more to be presented. Most of these will suffer the fate of many of those presented in the past; one or two papers will be published and they will be forgotten. Even excellent papers in the top journals get lost because no one has time to read everything - in one literature search for this refutation (discussed in Chapter Four) it was found that those people who cited Lancaster in a four year period had cited 6000 other references (and had largely ignored many other research programmes). This suggests that an excellent paper presenting a novel theory may well be overlooked.

The fact that so many competing theories exist reduces the credibility of all of them: they cannot all be right. The problem would be reduced if the less useful theories could be identified and discarded. Similar criteria could be used to establish which of the new theories should be tentatively admitted to the list of useful theories.

Lastly, testing should come up with a way of determining where the theory can be applied. Lancaster does not expect his theory to work for all products in all markets, though he clearly expects it to work in some situations where the restrictive assumptions of its formal theory do not hold. However, some of his followers use it where none of its assumptions hold. A theory is of little use if one cannot say when it should hold. If it can be clearly stated exactly under what circumstances the theory can be expected to apply and under what circumstances it should be avoided, the theory becomes much more powerful.

TESTING

A distinction must be drawn between the appropriate method for testing a theory and the method of testing a model specific to one situation. A model that is right for one situation will have assumptions that are realistic for that situation, it will have internally consistent logic, and it will make accurate predictions. If any two of these conditions hold, the third will hold (with minor exceptions). A very powerful test of a model is whether it repeatedly produces accurate predictions.

Testing a theory is a different matter. Most economic theory is not intended to apply directly to the real world. It is built on assumptions which make analysis easy, and assumptions that are also very broad, so it can be adapted to a wide range of possibilities. It is not meant to make predictions about the real world, but rather to provide strings of logic (paradigms, perhaps) which can be incorporated into specific models, or to say "Perhaps something like this might happen in some real world

situations". This means that theories cannot be tested directly by their predictions. In this refutation Lancaster's theory is being tested only for its usability in real-world economics, both its applicability and its ability to tell us anything useful. There are of course other justifications for the theory, possibly implying other ways of testing. For example it may be considered simply an interesting exercise in how much theory can be developed from a handful of assumptions (e.g.Lancaster 1966 p132).[2] At the other extreme Lancaster (1979, Chapter 10) used it as a basis for universal generalizations on welfare, variety, the GNP, inter-industry trade between identical economies, the optimal division of labour, economic development and politics. It might be intended as an approximation of how people actually behave and, while Lancaster does not explicitly suggest that this is the case, some of his broad generalizations imply that this is what he meant from time to time.

These different interpretations of the status of the theory make effective refutation difficult. If it is just shown that the theory cannot be applied in real-world economics, some economists will ignore the criticism, on the basis that it might apply to services or that, in spite of the fact that it is unrealistic, it remains an interesting exercise in how much can be derived from a handful of assumptions. For a complete refutation, either the theory must be destroyed in each of its incarnations, or it must be destroyed at a basic level, before the different incarnations are distinguishable. This refutation, therefore, concentrates on basic problems in order that its conclusions should have wide applicability.

TESTING PREDICTIONS

One of the most influential approaches to the testing of theory is Popper's (1959, 1963) which may be summarized as follows:

"(1)   It is easy to obtain confirmations, or verifications, for nearly every theory - if we look for confirmations.

(2)   Confirmations should count only if they are the result of <u>risky predictions</u>; that is to say, if, unenlightened by the theory in question, we should have expected an event which was incompatible with the theory - an
event which would have refuted that theory.

(3)   Every 'good' scientific theory is a prohibition: it forbids certain things to happen. The more a theory forbids the better it is.

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[2]   See also: "The output, and thus the predictive power and analytical usefulness of any scientific theory is ultimately limited by the input into that theory. At the same time good theory should be efficient, in the sense that it should not use more informational input for given predictive output than the minimum necessary" (Lancaster, 1971, p.1).

(4)   A theory which is not refutable by any conceivable event is non-scientific. Irrefutability is not a virtue of a theory (as people often think) but a vice.

(5)   Every genuine test of a theory is an attempt to falsify it, or to refute it. Testability is falsifiability; but there are degrees of testability: some theories are more testable, more exposed to refutation, than others; they take, as it were, greater risks.

(6)   Confirming evidence should not count <u>except when it is the result of a genuine test of the theory</u>; and this means that it can be presented as a serious but unsuccessful attempt to falsify the theory. (I now speak in such cases of 'corroborating evidence').

(7)   Some genuinely testable theories, when found to be false, are still upheld by their admirers - for example by introducing <u>ad hoc</u> some auxiliary assumption, or by re-interpreting the theory <u>ad hoc</u> in such a way that it escapes refutation. Such a procedure is always possible, but it rescues the theory from refutation only at the price of destroying, or at least lowering, its scientific status (I later described such a rescuing operation as a '<u>conventionalist twist</u>' or a '<u>conventionalist stratagem</u>').

One can sum up all this by saying that <u>the criterion of the scientific status of a theory is its falsifiability, or refutability or testability</u>." (Popper, 1963, pp.36-7).

Is Lancaster Scientific?

Popper's criteria fit specific economic models, as opposed to economic theories, very well. Models are clearly scientific in the sense that they make precise predictions, and the models can be rejected if they consistently give bad predictions.

Popper's criteria would say that Lancaster's theory is unscientific because the theory makes no testable predictions about the real world: it is a scenario of an imaginary world. It shows only that if certain unrealistic assumptions are made, certain outcomes can be predicted. Since many of these assumptions are most unlikely to hold in practice (perfect knowledge, for instance) the fact that the predicted outcomes do not hold is no surprise to anyone. This is not a criticism of Lancaster: the same can be said of most economic theory. Most theory provides a string of economic logic or paradigm cases, not in themselves testable, which can be used to build up specific, testable, models of real markets. Theories of monopoly or imperfect competition, for example, need a lot of adjustment in the form of realistic assumptions before they can be applied to any one situation.

This means that Lancaster's theory is non-scientific because it does not make testable predictions, but it does not mean that it is useless. Popper is emphatic that "if a theory is found to be non-scientific, or 'metaphysical' (as we might say), it is not thereby found to be unimportant or insignificant, or 'meaningless', or 'non-

sensical'", (Popper, 1963, p.38). He gives the example of Darwin's theory as being untestable but being an extremely valuable "metaphysical research programme" and a possible framework for testable scientific theory (see Popper, 1976, pp.168, 171-80, 1972, pp.69, 241-2, 267-8).

Indirect Tests of Lancaster's Predictions

It may be possible to test a theory's predictive power indirectly, by examining whether specific models which make some use of Theory A predict better than specific models making use of Theory B, and particularly if they make predictions that Theory B does not. If they generally do, it may seem reasonable to reject Theory B, as we would reject a specific model that was a poor predictor. How many tests would be required and what proportion of "successful" predictions would be required before we could draw this conclusion? Obviously, the less reliable the tests, the more observations would be required. "Sophisticated falsificationists", who include Popper himself (1959 p.113, 1972 p.257, 1976 p.42) and Lakatos (1970), do not believe that it is a simple or straightforward matter to test even a model, and would argue that any test is unreliable, for reasons which are set out below.

The first and most important requirement of such a test is that it must be possible to say unequivocally that the theory can be applied in this situation.[3] If it is possible to reject unwanted results on the grounds that "the assumptions of the theory cannot have applied in this case" no meaningful test is possible. In this refutation, Chapters Two and Seven in particular, it is argued that it is not possible to say in practice whether Lancaster's assumptions hold in any given situation. This alone makes it impossible to test the theory in this way.

A test is not just a question of which model produces the best fit in one particular situation. Popper is emphatic that "confirming evidence should not count <u>except when it is the result of a genuine test of the theory</u>" (1963, p.37). This implies that the competing models should have made their predictions before the observations are made. A real test requires that one theory predicts different outcomes to its competitors, not just that it predicts the same outcomes more accurately. It is particularly desirable that one theory should make predictions that other theories forbid. Most of the theories of quality were drawn up to explain the same phenomena, so, in practice, they should predict the same outcomes, with more or less accuracy. A great deal of skill is needed to devise crucial experiments where models using one theory make predictions that others do not. Sometimes one theory has the

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[3]   "While a prediction that almost anything might happen is universal enough, it is the product of an empty theory unless the circumstances under which each of the possible outcomes will occur are specified". (Lancaster, 1971, p.1).

potential of making predictions that others do not, but even so, it is a matter of luck whether in any situation the data are such that they will in fact make different predictions for that situation. All this means that many attempts at crucial experiments would be needed to achieve even a few that were in fact crucial.

Any crucial test demands that all the models being tested should be applicable to the same situation, and that all the theories should be appropriate. If Theory A is designed for one type of situation and Theory B for another, the theories are incommensurable, and cannot be compared (see Blaug, 1980 p.26; Kuhn, 1962; Feyerabend, 1962). To the extent that the competing theories have different domains and different boundary assumptions, testing by predictions is impossible.

Competing theories may also perform better in different ways: one may be more accurate, the other more reliable; one may work well for durable goods, one for fast-moving consumer goods.

It is not legitimate to trawl through the literature or run a series of tests to come up with the conclusion that models using Theory A tend to produce more accurate predictions than models using Theory B, and that, therefore, Theory A is a better predictor. If the theories are incommensurable, or have only partly overlapping domains and if the theories are perfect in all respects, Theory A will give excellent results in the markets it was designed for, and Theory B will give better results in the markets it was designed for. Theory A will seem better if most of the examples chosen are of the type of market it was designed for. Any search of the literature will turn up mainly examples where only one of the theories was used, so no direct comparison is possible. Generally, in fact, there was no attempt to test Theory A, or even to test the model using Theory A; instead Theory A was used as one component in a model testing something quite different like consumer reaction to labelling of soft-drink cans. Choosing "random markets" for a test is conceptually difficult and makes interpretation difficult - what does it mean to say that, in 60% of cases, models using Theory B are more accurate or more reliable than models using Theory A?

This argument is sometimes inverted, to say "Models using Theory A are better than models using Theory B in 75% of cases, so the assumptions on which Theory A are based, on consumer preferences for instance, hold in 75% of cases". The implication is that the frequency with which a given set of assumptions apply is the hypothesis being tested, not, as before, which theory works better when its assumptions apply. Indeed, it is tacitly assumed that the theory works perfectly when its assumptions hold, with the accuracy of predictions falling off slowly in line with the accuracy of assumptions. It is not telling us that Theory B does not hold in all situations: we know that anyway. Getting a random sample is an insuperable problem. The logic is not perfect, especially in ignoring other theories, and ignoring practical problems set out below. It is certainly not a crucial test. The value of the exercise is also obscure: it would suggest that if you knew nothing about a market, its products or its

consumers, your best bet would be to try a model using Theory A. The alternative of checking fundamental assumptions and boundary assumptions against reality in that specific market is surely more powerful.

Still less can one trawl through the literature and find examples where models making use of Theory A sometimes make predictions that are not falsified by the results, so the theory must be held to be "the correct theory". Quite apart from the logical error here, the difficulty of publishing negative results means that it would be surprising if this were not so.

In any such literature search we cannot be sure that the authors who say they have used Theory A have understood it and used it correctly.

Practical Problems

Even if attempts at crucial tests are made, there are many reasons, a lot of them valid, why people who like Theory A would refuse to be convinced by a few results which appear to refute it. These reasons also explain why the result that "Models using Theory A appear to give better predictions than models using Theory B" carries very little weight.

In any specific model, Theory A on the consumer demand for product quality will only be part of a model which may take into account market structure, price, income group of consumer and so on. The fact that the model is a good or a bad predictor may have nothing to do with Theory A. Indeed, errors in Theory A and the rest of the model may well cancel out (this might not be so with repeated tests, but in practice it is often possible to observe only one or two outcomes, and it is seldom possible to adjust the inputs so several predictions based on very different data can be checked against outcomes).

There are always errors arising from data problems, market fluctuations, changes in the supply of substitutes and so on. This means that no one is going to be convinced by a single disconfirming result, or several - even if the test is perfect in all other ways.

Is it Worth Testing Predictions?

The naive falsificationist interprets Popper's description of how Eddington's observation of the transit of Venus in 1919 refuted Newton, as an indication that while it is never possible to prove a theory, one experiment can disprove it. Sophisticated falsificationists like Popper and Lakatos are only too well aware how difficult it is to refute a theory. They have accepted a very different balance, and

believe that a large number of experiments are needed to disprove a theory in physics or chemistry. In the present case of an economic theory which is itself non-testable and therefore non-scientific in its direct form, any tests must be indirect, and an even larger number of disconfirming results would be needed before their theory was taken to be refuted.

From the discussion above it would seem that testing Lancaster's theory by testing predictions of models making some use of it is not feasible.[4] It is difficult to design crucial experiments, it is difficult or impossible to compare it with incommensurable theories. There are many reasons why disconfirming evidence may be ignored.

It is questionable whether even a dozen crucial tests, all of which produced disconfirming evidence, would noticeably affect the level of acceptance of Lancaster's theory. Given the data problems, problems arising from the use of inappropriate models and so on. discussed above, it is unlikely that even a very bad theory would get consistently bad results. This means that many more tests would be needed to produce the same disconfirming effect as the dozen crucial tests with consistent results.

The resources, including time, needed to carry out a crucial test mean that it is extremely unlikely that anyone will ever fund a research programme on this scale - especially when it is extremely doubtful whether the results will have any effect on whether the theory is generally accepted by the profession.

TESTING ASSUMPTIONS

If a model has internally consistent logic and realistic (even though simplified) assumptions, its predictions will be accurate. It is quite normal to test a model of a specific market for realism and consistency in the past. For example, it is easy to check a model's assumptions for realism, and as the model also makes predictions about market behaviour, it can be tested by the accuracy of the predictions in the past. Typically a model can be tested against many outcomes that are not contained in the original assumptions. Typically too, in real-world economics the aim is to produce a model which incorporates as much of observed reality as can be managed, rather than one which makes the fewest possible assumptions, so most models are overspecified and can easily be tested for internal consistency. When the model is used to predict the future, though, only a single outcome can be observed - what actually happens -   so tests based on predictions may be less powerful than tests

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4   Feyerabend puts it, "the most important point is this: it is hardly ever the case that theories are directly concerned with 'the facts' or with 'the evidence'" (1970, p.204).

based on internal consistency.

It is not possible to test a theory in the same way, as its assumptions are not intended to be a realistic picture of any one situation. The predictions of a theory can only be "wrong" when
- they are self contradictory, or
- the implications contradict each other.

That is to say a logically consistent, though possibly totally unrealistic, theory can be built on any set of assumptions that are not wrong in this sense. Such a theory may however be built on assumptions which, while internally consistent and therefore not "wrong", exclude all possible real life situations. This refutation is concerned with whether a theory is applicable to real-world economics problems, so theories like this are instantly rejected.

An acceptable theory must have assumptions which are realistic, not in the sense that they apply exactly to one situation, but in the sense that they are broadly true in a range of real life situations. This implies some simplification and abstraction from reality, but not unreality. If the assumptions are not realistic, they cannot be applied to a real life situation without major changes, which implies reworking the whole of the theory from the new assumptions.

The theory must be applicable to a reasonably large range of real life situations. It would be a waste of time to build up a complex theory that applied only to a handful of unimportant transactions.

If must be possible to say in advance whether or not a given theory could be used in a given situation. If it is not possible to say this with or without hindsight, the theory has no value. If it is only possible to do it with hindsight, the value of the theory is very limited - it is no good for prediction for instance.

Simplifying Assumptions

Every theory has simplifying assumptions. This is necessary both so it can be adapted to a wide range of real life situations and to keep the analysis manageable. Every model has simplifying assumptions, because trying to include all reality in the model would require too big a model.

Because everyone agrees that some simplification is necessary, criticisms of a theory or model for oversimplification are unlikely to carry much weight. However, it must be realized that where judicious simplification can produce a simple but realistic theory, injudicious simplification, like assuming perfect knowledge for search theory, can ruin it. Again, while a theory is unlikely to be oversimplified, a model may very well be.

Fundamental Assumptions

Every theory has a set of assumptions, usually implicit, which are fundamental to the whole analysis. These may be what the author believes to be broadly true everywhere, not just within the domain of his or her particular theory. The assumptions are fundamental, like the assumption that in general consumers prefer more of a good to less.

Many of these assumptions are theory laden. Assumptions on the shape of an indifference curve, for example, bring in a chunk of economic theory. For this reason it is not possible to fix a hard and fast distinction between assumptions and logic.

If the fundamental assumptions can be shown to be self-contradictory or to be totally unrealistic, all the theory built on the assumptions falls away.

Boundary Assumptions

It is not feasible to produce a theory that covers all possible situations, and is applicable to every instance where the fundamental assumptions hold. Boundary assumptions might be brought in to define the domain of this theory as being only where there is a monopoly, for instance. The theory is only intended to apply where both the fundamental assumptions and the boundary assumptions apply. As the concept is used here the boundary assumptions become an integral part of the analysis: the author is not saying "The theory applies in a wide area: I am confining the discussion to a subset of these, defined as follows . . . , but the theory remains equally applicable elsewhere."

The boundary assumptions are wrong if they are self contradictory, or if they contradict other assumptions. If the boundary assumptions are so unrealistic that there is no possible real life situation within the boundaries, the theory is useless, if not "wrong". Lancaster accepts that this is true of his 1975 paper on quality:

> "At that stage it was not realized by the author that there are no viable market structures in the paradigm case, and thus there are some important errors in the paper" (Lancaster, 1979, p.13).

Boundary assumptions can also be criticized as being over-restrictive, so they have very little application to real life situations. This does not mean that the theory is formally wrong, just that it is unimportant.

Ad Hoc Assumptions

A theory may contain <u>ad hoc</u> assumptions which are included not to make the theory more realistic, but because the theory will not work without them. Typically they are unrealistic and each reduces the application of the theory to fewer and fewer cases. The distinction between <u>ad hoc</u> and boundary assumptions is not always clear, but boundary assumptions tend to be separating out a slice of reality to study, while <u>ad hoc</u> assumptions assume away reality.

<u>Ad hoc</u> assumptions are criticized mainly because they reduce the explanatory power of the theory. Instead of a theory which holds wherever the fundamental and boundary assumptions hold, we have a theory which only holds in a special case. If a series of <u>ad hoc</u> assumptions are introduced, the coverage of the theory may rapidly fall to zero.

<u>Ad hoc</u> assumptions are particularly likely to produce contradictory assumptions and "wrong" theory. Every explicit assumption introduced produces some implicit assumptions. Assuming perfect information, for example, has a great many implications on the type of characteristic, the education of the consumer, the type of retailing, advertising and branding for instance. If the assumptions introduced are realistic, neither the explicit nor implicit assumptions are likely to be contradictory. Without this constraint of realism, though, it is only too easy to feed in contradictory assumptions. It is also possible to introduce assumptions which, if explicit, would be rejected as ridiculous.

Occam's razor requires economy of assumptions, but the point must be made that because each explicit assumption introduces implicit assumptions, a model with very few explicit assumptions may have a great many indefensible implicit assumptions.

Ceteris Paribus Assumptions

<u>Ceteris paribus</u> assumptions are used to hold other factors constant while one is concentrating on one part of the theory at a time. They are a valuable aid to analysis. However, they should be dropped once they have served their purpose. If the assumptions are not dropped, they are in fact <u>ad hoc</u> assumptions, or perhaps boundary assumptions, and are open to the same criticisms.

LOGIC

If the logic of the theory is wrong, the theory is wrong: realistic assumptions plus bad logic mean the wrong conclusions. If there is a logical error at any stage, all the theory that depends on it is wrong: either it must be reworked, or it must be

discarded. Errors in logic at the basic level mean that the whole theory must be discarded, while errors at a later stage means that some of the superstructure must be discarded.

The distinction between logic and assumption may not be as clear as it seems at first sight. The choice of assumptions and the specification of assumptions is not made arbitrarily, but because it fits into theory. Lancaster's assumptions on consumer preferences, for example, are expressed as assumptions, but were chosen because they are very similar in appearance to some of the conclusions of consumption economics so they incorporate this theory. To this extent it is possible to say that assumptions are wrong in the sense that the logic contained in the assumptions may be wrong.

IMPLICATIONS OF CRITICISMS

With a model of a specific situation one can often respond to a criticism of the assumptions by changing the assumptions and seeing what effect this has on the conclusions. This will have the effect of showing whether the model is sensitive to changes in certain assumptions. It will normally be the case that a specific model, and its assumptions, are changed from time to time, both in response to changing circumstances, and in an attempt to quantify the impact of different actions. It is common to feed in different assumptions, in the form of data.

The implications cannot be assessed as easily when the assumptions or the logic of a theory rather than a model are challenged. The theory does not address reality, so the change in predictions cannot be quantified. More seriously, a rigorously constructed theory, like Lancaster's, goes from basic assumptions to logic, to further assumptions and then to further logic step by step, with each step building on the previous structure. The result of a flaw in the logic or the assumptions at step 50 is not to change the predictions in some quantifiable way: it is to invalidate all steps in the theory after step 50. The nearer to the beginning of the logical chain the error is detected, the more of the theory is invalidated.

The critic of the theory need only say which areas are invalidated. It is not necessary that a new theory should replace it. Indeed, the criticisms produced may imply that it is not worthwhile or desirable to try to push the theory in that particular direction: they may suggest that it will be more profitable to take a different set of assumptions and see where these lead. The alternative to a largely invalid theory is likely to be a completely different theory, rather than an attempt to reconstruct a bad theory.

THE APPROACH OF THIS REFUTATION

For the reasons given above this refutation will not test the predictive power of

Lancaster's theory. Instead, it will concentrate on testing the assumptions and the logic. In particular it will try to show that:

> The assumptions are wrong in that they or their implications are self-contradictory.

> The assumptions are so unrealistic that they cannot apply to real life situations.

> The assumptions are so rarely applicable that the theory is worthless.

> It is not possible to state either before or after examining a given situation whether the assumptions hold there, so it is not operational.

> The logic is wrong.

WHAT THE REFUTATION WILL NOT COVER

It is impossible to cover all aspects of quality in this refutation. Quality is important in virtually all transactions, so a full coverage would start with the most advanced micro-economic analysis, add dimensions for the different quality characteristics and develop from there, producing an infinitely more complex analysis. Even at the macro level, quality comes into discussions of the growth of the Japanese economy, for instance.

For this reason this refutation concentrates on testing the theory at a fundamental level. It avoids relatively minor criticisms of logic, especially those at later stages of Lancaster's theory: these might be regarded as nit-picking, and would certainly distract attention from the main points.

Everything that was not relevant to the test has been excluded. For example, it can be argued that grades and brands are an integral part of any realistic theory of quality and I have discussed them at length elsewhere (e.g. Bowbrick 1976, 1982, 1992). Lancaster's failure to take them into account is certainly a weakness, but it is a weakness shared by many other theories. Again, it is widely believed that service quality, perception, information and search are important, but Lancaster has assumed them away by boundary assumptions, and his theory can be tested without recourse to them. Garvin's (1988) dimensions of quality can be ignored because Lancaster's theory does not change whether they are accepted or rejected.

In a refutation on economics an economically rational approach to tackling the problem must be adopted. There are limitations in the resources available for this study, so it is necessary to concentrate the resources available on those areas where

16

refutation is most likely to be achieved. It would be irrational to give much time or effort to interesting little errors or limitations that do not have wide application. Similarly, it would be irrational to discuss errors in step 3 of an argument, if steps 1 and 2 have been shown to have unrealistic assumptions or wrong logic.

OUTLINE OF THE ARGUMENT

In Chapter Two the structure of Lancaster's theory is set out, showing how it is based on fundamental assumptions, boundary assumptions, ad hoc assumptions and ceteris paribus assumptions and showing how logic is applied to these to produce the theory. On the basis of this it is shown that much of the theory can be excluded from further discussion.

Chapter Three provides a detailed exposition of Lancaster's theory, following his own presentation closely.

In Chapter Four different approaches to quality in the literature are discussed. It is shown that some have a strong family resemblance to Lancaster, differing mainly in their boundary assumptions, while others, more distantly related, still share some fundamental assumptions. Work within Lancaster's research programme is reviewed and it is shown both that he still completely dominates the programme, and that there has been little effective criticism of it.

Chapter Five examines the validity of Lancaster's fundamental assumptions on consumer preferences.

Chapter Six examines the validity of Lancaster's fundamental assumptions on price and supply.

Chapter Seven examines the fundamental assumptions on the objectivity of characteristics, and examines the implications of introducing a degree of subjectivity to the analysis.

Chapter Eight asks whether it is in fact possible to determine at any time whether or not Lancaster's assumptions apply in any real situation.

In Chapter Nine the results are brought together and conclusions are drawn.

LANCASTER'S   THEORY   OF   CONSUMER DEMAND

In Chapter Three Lancaster's theory of consumer demand will be set out, following his exposition closely. Before this is done, the present chapter will explain the framework of the theory, what its assumptions are and how it is built up. The chapter will also draw attention to some weak points in the argument.

For the purpose of this refutation it is convenient to distinguish between the following phases of the argument, which may be called Lancaster One, Lancaster Two, Lancaster Three, Lancaster Four and Lancaster Five:

LANCASTER ONE

This argument is presented in Lancaster (1966) and in the first five chapters of Lancaster (1971). It arrives at a paradigm case for individual consumer demand, and a paradigm case for the aggregation of this to examine market demand.

LANCASTER TWO

Chapters six, seven, eight and nine of Lancaster 1971 extend the theory from the basic paradigms "towards application".

LANCASTER THREE

Chapter 10 of Lancaster (1971) presents a practical example relating to consumer demand. As the assumptions are not those of the paradigm cases it must be dealt with separately.

LANCASTER FOUR

In Variety, Equity & Efficiency (1979) the theory in Lancaster One and Two is set

out, with modifications, to be the basis of Lancaster Five.

LANCASTER FIVE

The remainder of Variety, Equity & Efficiency is a neo-Chamberlinean approach to welfare based on the analysis developed earlier. It does not fall within the scope of this refutation.

Lancaster's (1966) paper set out an outline of the basic theory, but it was set out fully with explicit and slightly different assumptions and other modifications in Consumer Demand (1971). For the purpose of this refutation Consumer Demand is the definitive exposition of the argument. This was followed in 1975 by a paper examining the welfare implications of the theory, but Lancaster recognized that its argument required a market situation that could not exist, and presented Variety, Equity & Efficiency (1979) as a revised and correct version of the argument.

THE OBJECTIVE OF THE THEORY

Lancaster's theory "originated from the observation that traditional demand theory was ignoring highly pertinent and obvious information, the properties of goods themselves" (1971, p.2) and he proposed to concentrate on this aspect "After all, one would expect information on the properties of goods to be more easily obtainable and to be more universal in character, than properties of individual's [sic] preference orderings" (1971, p.2).[5]

WHAT ARE CHARACTERISTICS?

WHAT PEOPLE VALUE AND WHAT CHOICES ARE BASED ON.

The first assumption, basic to everything that follows, is that each good has characteristics relevant to the choices people make on goods (Lancaster, 1971 p.7).

In his earlier paper (1966) a stronger assumption had been made.
> "The good, per se, does not give utility to the consumer; it possesses characteristics, and these characteristics give rise to utility" (1966,

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[5]   Throughout the analysis the traditional demand theory referred to is the Slutsky Hicks approach, not older traditions of quality analysis using characteristics, like Waugh (1928).

p.134).

In this discussion, these assumptions are interpreted as being about both how individuals think and how they perceive: they are not about the properties of goods, though Lancaster's wording could be taken as implying that they were. The distinction between the 1971 and the 1966 assumptions is potentially interesting and useful, focusing on the distinction between preference and choice, but the assumptions become identical as further assumptions are introduced:

- people always act in accordance with their preferences (1971, p.21).
- there is perfect knowledge.

This means that people value goods purely for their characteristics and that they choose between them purely on the basis of their characteristics. This implies that characteristics which do not influence choice or utility are irrelevant to the analysis - by assumption it is not possible to have a characteristic which confers utility but does not affect choice.

CONSUMPTION TECHNOLOGY

Lancaster uses the term "consumption technology" to explain the relationship between the products purchased and the characteristics obtained from them. In the first paradigm case this is a simple matter of adding the characteristics from the different goods purchased, as will be shown below.

CHARACTERISTICS SPACE

Lancaster's analysis is carried out in characteristics space, rather than in goods space. That is to say preferences and prices are plotted on surfaces with characteristics as axes, rather than, as in traditional analysis, with goods as axes.

In Figure 2.1. X indicates the quantity of characteristics A and B that can be obtained from a given quantity of Good X.[6] Points along OX indicate the quantities of characteristics A and B which can be obtained by purchasing different quantities of Good X. Similarly, OY and OZ indicate the quantities of Characteristics A and B that can be obtained from buying different quantities of Good Y and Good Z, which contain different quantities of the characteristic.

If an individual consumer can mix characteristics from different goods we get the position in Figure 2.2. The line XYZ indicates the maximum quantity of characteristics A and B which can be obtained by mixes of X, Y and Z (with the

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[6] Lancaster uses "good" to mean one unique mixture of characteristics, so different types of coffee, for instance, are different goods in a group of goods called coffee.

linearity assumption set out below).

One advantage of analysis in characteristics space is that it makes comparisons easier. It is possible to plot twenty two-dimensional goods on a single two-dimensional figure like Figure 2.1, while if the analysis were in goods space, there would be twenty dimensions.

ASSUMPTIONS ON PERCEPTION AND REACTION

It is assumed that

> "Individuals differ in their <u>reactions to</u> different characteristics rather than in their assessment of the characteristics of different goods collections . . . preferences for goods are <u>indirect or derived</u> in the sense that goods are required only in order to produce characteristics"
> (Lancaster 1971, p.7)

Lancaster refers to this assumption of "universality and objectivity" as one of two fundamental assumptions.

The assumption is a boundary assumption ruling out situations where there is imperfect information, where advertising or search are important or where individuals vary in their perceptions or beliefs about the level or existence of characteristics in a goods collection.

Where the boundary assumption does hold, the approach is powerful and attractive. It means that the theory can handle cases where people have widely different valuations for different characteristics combinations and where there are different end uses. It also means that it is possible to concentrate analysis on easily measured characteristics and to ignore the psychological aspects of demand, which are more difficult and more expensive to measure.

Lancaster does not discuss the situation where individuals with different end uses might perceive characteristics in completely different ways and measure them differently. In some cases it might be argued that the characteristics should then be treated as different characteristics when they have different end uses. Similarly, while the protein in steak and in shoe leather are formally the same characteristic in his formulation, it might be argued that people buying shoes do not perceive the protein, so it is a different characteristic. Treating them as separate characteristics widens the applicability of the theory without reducing its rigour.

QUANTITATIVE   AND   OBJECTIVELY   MEASURABLE CHARACTERISTICS

It is assumed that all characteristics are quantitative and objectively measurable (Lancaster 1971 p.5). This is an assumption on how individuals perceive the

characteristic as well as on its being objectively measurable.

It is an extremely limiting boundary assumption. It rules out all those situations where subjective perception and belief differ from what is objectively, quantifiably measurable. It rules out all considerations of attributes - how an individual interprets his or her perception of objective characteristics. Taste, beauty, texture and smell for example, are subjectively perceived, though there may be a large measure of common subjectivity within a culture or a lifestyle group, and in some cases this may be correlated with some objective measures of chemical content and so on. Descriptions of a piece of music, a car or a meal usually include some attributes that are clearly subjective even if they are in principle definable by a scientist or engineer in quantifiable, objective terms.

The requirement for objectivity implies that all individuals and the objective outside observer (the market researcher perhaps) must see the characteristic in the same way. The requirement that the characteristic is measurable does not appear to imply that consumers measure it, only that it can be measured for purposes of market research and analysis. For example, consumers may be in agreement about the relative crispness of different types of apple, but only food scientists with shear presses can measure it.

There is an explicit assumption that not only do all consumers and outside observers see the same characteristic but they measure it in the same units. There may, however, be several objective ways of measuring a characteristic: the scale might be linear or logarithmic, it might be total units of each characteristic or percentage of a characteristic (e.g. 20:20:10 fertilizer) or "cleaning power per dollar". For example, Lancaster uses "engine quietness and performance" as a characteristic in one of the two practical examples in Consumer Demand (1971, p.170). Engine power might be measured in terms of cylinder capacity, time taken to reach a certain speed, acceleration at cruising speed, ability to tow a caravan, BHP and so on. It cannot be expected that all these facets of engine power would be directly relevant to all consumers, so any one unit would be inappropriate.

The assumption on universality and objectivity of characteristics is important to the theory. Without it, it is not possible to plot two individuals' response to characteristics on the same axes, and the comparison of individual demand and the aggregation into market demand using Lancaster's approach is not possible. In practice, there is a strong possibility that a market researcher or food scientist will use whatever objective measure is easiest, even if it has little relation to how consumers value the characteristic. Taken in this context, Lancaster's explicit assumption

> "The 'unit' in which a particular characteristic is measured is unimportant except that it must be the same for all the goods possessing the characteristic and maintained throughout the analysis"
> (1971)

is either incorrect analysis if it is intended to be generally true, or is a highly restrictive <u>ad hoc</u> assumption restricting the theory to those situations where it does apply.

It will be noted that if a consumer's perception on even a single significant characteristic out of those that influence his or her choice does not meet the assumptions, the analysis can not proceed.

THE LINEARITY ASSUMPTION

It is assumed that if one has x times as much of a good, one has x times as much of each characteristic (Lancaster, 1971, p.15). This is an assumption about the perceptions of the consumers: it is not an assumption about the physical properties of the good, which may include characteristics of no interest to consumers. It is not an assumption about preferences "if the second piece of pie does not taste as good as the first, it is not because the characteristics of pie are non-linearly related to the quantity, but because preference relationships are non-linear" (Lancaster, 1971, p.107). It also implies that goods are perfectly divisible.

This is an extremely limiting boundary assumption. It rules out many characteristics which occur commonly. For example, two red apples are no redder than one, two curries are no hotter than one, two oranges are no sweeter than one, two shop assistants are not twice as polite as one. Of course, with sufficient imagination one can usually identify some characteristics which are additive, the quantity of red pigment, capsaicin (which gives the chilli its "hotness") or sugar, for instance or the number of times someone says "Have a nice day" and measure these quantitatively and objectively. However, the assumption discussed above requires that all consumers perceive the same characteristics as the objective observer, and since few have any concept of the red pigment content of an apple, the approach would be quite invalid in these cases.

ADDITIVITY ASSUMPTIONS

"Given quantities of the two goods x_j and x_k the total amount of the ith characteristic possessed by the goods collection (x_j , x_k) is the sum of the amounts of the characteristic possessed by x_j x_k separately" (Lancaster, 1971, p.15). Lancaster (1971, p.17) illustrates his assumptions of linearity and additivity with a diet example, where people try to optimise their intake of calories, protein and vitamin A from different goods. This has obvious similarities to the real-world economist's least cost feed problem, from which Lancaster's theory was developed. Again, this is an assumption about perceptions, not goods or characteristics, though it may be linked to the physical properties of goods.

Some implications of this assumption are
- One unit of the characteristic, protein say, gives the same utility whether it is consumed in the form of steak or potatoes.
- Consumers get the same utility from a given quantity of a characteristic, protein say, whether it is all contained in one good, or in a mixture of several.
- Consumers perceive, and value, mixtures of goods in terms of the total quantity of characteristics they supply.
- There is no quiddity: a steak is only a mix of characteristics, not a steak, and is no different from the same mix of characteristics obtained by mixing other goods.

Linearity and additivity are extremely restrictive boundary assumptions. Apart from the diet example, which is not a common problem in consumer demand, it is difficult to give examples of problems to which it might apply. The theory depends on the assumptions and cannot proceed to the first paradigm case without them.

ASSUMPTIONS ON PREFERENCES

Lancaster's assumptions on preferences "simply carry over traditional preference theory applying it to collections of characteristics instead of to collections of goods" (1971, p.20). These assumptions are:
1. The consumer has a complete quasi-ordering over the set of all possible characteristics collections". This requires
   a) transitivity
   b) completeness
2. Continuity
3. Strict convexity.
"In other words, these three assumptions enable us to summarize the consumer's preferences in terms of a utility function, whose contours (indifference curves) are strictly convex towards the origin" (1971, p.20). It is also assumed that
4. There is non-satiation.
5. All characteristics are positively desired.
These last two assumptions are looked at again at a much later stage of <u>Consumer Demand</u> and slightly modified but for the moment they remain. These five assumptions "guarantee that the consumer's preferences can be expressed in terms of an ordinal utility function of the neoclassical kind, with all its first-order partial derivatives positive", (1971, p.21).

The assumption results in indifference curves plotted in characteristics space looking like the textbook examples of indifference curves in goods space (see Figure 2.3. and also Lancaster 1979, pp.18-19). This assumption appears to be made in the belief

that it is broadly true for all individuals in relation to all collections of characteristics, in the same way that it might be said that indifference curve analysis is broadly true for all collections of goods. It may, therefore, be interpreted as a fundamental assumption, rather than a boundary assumption. Again, the analysis cannot proceed to the first paradigm case without the assumption.

ASSUMPTIONS ON THE PRODUCT

Lancaster's assumptions on the product are largely implicit. Inevitably, the way in which a product is perceived is in some way linked to what it is. The fact that two cars do not travel twice as fast as one or that the speed of a car cannot be added to that of a bicycle is something more than the perception of an individual. So, too, is the perception, assumed by Lancaster, that the good is available in infinitely small increments. This means that, using common sense, one can instantly reject the use of Lancaster's theory in certain cases, even if one knows nothing of the preferences of individual consumers.

ASSUMPTIONS ON PRICES

In indifference curve analysis of goods it is usually assumed that the goods are positively priced. More of a good can be obtained by paying more and the budget constraint limits the quantity that can be purchased. By assumption, consumers prefer more of a good to less, so the purchase is on the budget line.

Lancaster's initial assumptions appear to be:
1.   Goods are positively priced.
2.   The price of a good is independent of an individual consumer's actions.

If a consumer has a fixed sum of money, all of which has to be spent on a single good, the possibilities are as in Figure 2.4. Each vector shows the maximum quantity that can be bought with A, B, C, D and E indicating the maximum amount of each characteristic that can be obtained by spending the whole amount on one good. Points on OA represent characteristics combinations that can be purchased by spending a smaller amount on good A. The points, A, B, C, D and E are a <u>feasible set</u>.

If we now introduce the boundary assumption of additivity, so that it is possible to combine two different goods to produce a new characteristic mix, the situation is as shown in Figure 2.5. With a given sum of money one can buy all A or all B or a mix represented by a straight line between the two.   The maximum quantity of characteristics that can be purchased with a given sum of money is shown by the line A B D E. If C is purchased, fewer of both characteristics will be obtained than if a

mixture of B and D is purchased.

Without assumptions on preference we have no reason to suppose that any point is of more interest than another. However, Lancaster's fundamental assumption is that characteristics are positively valued, so more of a good produces more utility. If two goods are otherwise identical, the one with more of a characteristic produces more utility. The consumer wants the maximum total utility. In Figure 2.5, therefore, the curve ABDE represents not just the maximum total quality that can be brought but also the quantity that an efficient buyer will buy. Lancaster refers to this as an efficiency frontier (1971, p.35). While Lancaster repeatedly states that this is objective, it does depend crucially on his assumption that characteristics are positively desired.

The implications of these assumptions on supply are obscured by the other assumptions. They will become clear in Chapters 5 and 6.

COMPARISONS BETWEEN INDIVIDUALS

An important aspect of Lancaster's theory is that it provides a way of comparing the choices of different individuals, and explaining why different people buy different goods (or what other people might call different qualities of the same product). He does this by mapping their choices on the same figure. In order to reach the situation where "the one mapping will suffice for all consumers facing the same market conditions" (Lancaster, 1971, p.24), he has to make a range of new assumptions.

"For consumers facing the same market conditions, the individual budget constraints differ only in the value . . . of the income.

"The goods characteristics relationship . . . is the same for all consumers.

"This relationship is also linear . . . This means that the feasible sets (in characteristics space) of different consumers is simply related by scalar expansion in proportion to the ratios of their incomes" (1971, p.24).

- All consumers perceive the same characteristics in the same way, though they may value them very differently.
- All consumers have the same perfect knowledge of characteristics and, it is implied, price.[7]
- It is assumed that all consumers face the same prices.
- It is implied that the goods are equally available to all consumers.

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[7] Lancaster does not treat price as a characteristic, and the assumptions have the effect of obscuring the price dimension.

These assumptions may be a reasonable approximation to reality in some cases, for people using a village market in Africa perhaps, or for people who are already within a certain supermarket and are buying certain goods with obvious characteristics. They are not a reasonable approximation when location, whether within a town or over a country, is important, when information about price or characteristics is limited or costly, or when purchases are not based on objective characteristics.

The assumptions are, again, highly restrictive boundary assumptions, restricting application to a few cases such as those described which are not relevant to most marketing situations.

THE BASIC PARADIGM CASE

The basic paradigm case derives from the foregoing assumptions and is shown in Figure 2.6. (Fig. 3.6. in Lancaster 1971) which brings together Figures 2.4 and 2.2.

There are axes z_1 and z_2 being the amount of characteristic A and characteristic B in total consumption. Four individuals' indifference curves are shown, and a feasible set. The optimum choices for the individuals are where the indifference curve is tangential to a facet at A, A' or at a vertex B' or B.

This paradigm case has been built up rigorously by Lancaster. Its assumptions have been made explicit and it depends on these assumptions. Lancaster is rigorous in his use of assumptions: it is necessary to make the assumptions described above to reach the basic paradigm case. Where the assumptions do not hold the analysis cannot apply. For instance, without the assumptions on objectivity of characteristic, people seeing the same characteristic in the same way and so on, it is not possible to plot different individuals' demand on the same diagram, and Figure 2.6 is not possible.

It has been shown that each of the boundary assumptions is highly restrictive (the fundamental assumptions will be discussed in later chapters). That is to say there are few real life situations of people and products to which the assumptions of linearity and additivity apply. There must be very few examples to which these assumptions plus all the other assumptions hold.

It is emphasized that the assumptions must apply to <u>all</u> significant characteristics, not just one or two, if the analysis is to be applicable. The fact that consumers may take linear, additive characteristics like calories, fibre and vitamin content into account when buying food, does make the theory applicable if they also take into account taste, smell, texture or brand image.

The initial presumption must, therefore, be that the assumption does not hold in a

particular case. Before the theory is applied to a particular case it should be shown that the assumptions do hold. If the theory is to be tested, this is absolutely essential, otherwise any unwelcome results can be rejected on the grounds that "the assumptions obviously did not apply here". One must then ask how it is possible to determine whether the assumptions apply to any one individual in any one situation. It is necessary to show that the assumptions apply to all the individuals whose preferences are shown on Figure 2.6. For further developments of the analysis it is necessary to show that the assumptions hold for most, if not nearly all, individuals in the markets to be examined. It will be argued below that this is not just impractical but impossible. If it were possible, clearly the expense of determining whether the theory was possible to apply in this case would remove some or all the advantages of working with easily and cheaply measured characteristics.

Lancaster's theory is based on the assumption that it is the total quantity of a characteristic in consumption that determines utility and that the characteristic can be obtained from one or several goods, and the diet example he gives suggests that it may come from a wide range of goods. This does raise the question of whether the analysis can apply if the assumptions apply to an individual in relation to say chocolate bars, or confectionery, but not to food in general or automobiles or clothes. It would appear that, in so far as sugar is a characteristic, the theory can only apply if the assumptions apply to preferences and perceptions of <u>all</u> products containing sugar, and, if sweetness is a characteristic, to those containing sweetener as well. Intuitively it would appear that preferences regarding automobiles and clothes are irrelevant. Where ever the line is drawn, the assumptions must apply for more than a single product group. Lancaster does not consider whether it is necessary to determine whether his assumptions hold, nor how it would be done.

PRODUCT VARIATION OR PRODUCT DIFFERENTIATION

Chamberlin distinguished between product differentiation and product variation. In traditional micro-economics a product is a product, wheat is wheat and there are no quality differences. Another level of analysis is product differentiation "in which the products of different sellers, though different, are all <u>given</u> so the only variables studied are price and quantity" Chamberlin (1953, p.3). A further level of analysis is of product variation where

> "'product' is used in the broad sense to include all aspects of the good or service exchanged, whether arising from the materials or ingredients, mechanical construction, design, durability, taste, peculiarities of package or container, service location or seller, or any other factor having significance to the buyer". "Products are not in fact 'given'; they are continuously changed - improved, deteriorated, or just made different - as an essential part of the market process". (Chamberlin, 1953, p.3).

Lancaster's approach is clearly product differentiation. A good is a unique mix of characteristics. He assumes away, explicitly or implicitly, nearly all the aspects of product variation.

SUBJECTIVE AND OBJECTIVE

Lancaster has laid great emphasis on the objectivity of the characteristics used, so some of the implications of this assumption will be examined in this section before the discussion moves to his second paradigm case. The implications are examined in more detail in Chapters 7 and 8 (see also Bowbrick 1992, p.14-27, 35-6, 212-244).

The consumer's satisfaction with a good is in his or her own mind, and no outsider can observe or measure this satisfaction directly. One cannot, therefore, talk about average levels or market levels of satisfaction.

A buyer cannot know the objective characteristics of a product, he or she can only have a perception of them which is more or less accurate. The buyer is also influenced by factors like:
-        The buyer's beliefs about his or her own wants, beliefs which may be mistaken - I may think I want a fast car when I really want status.
-        The buyer has a belief which again may be mistaken, about which characteristics will satisfy these wants. The placebo effect complicates this - if the characteristic does not meet my needs but I think it does, I may get a similar satisfaction.
-        The buyer has a belief, which again may be wrong, about which goods on the market contain which characteristics and in what amounts.
-        The buyer has a belief about the price of the product and its component characteristics.
This means that consumers with identical tastes and incomes who face identical choices in terms of objectively measurable characteristics may end up with different purchases. A large marketing effort goes into identifying the discrepancies between the perceptions and beliefs of different consumers and discrepencies between the perceptions and beliefs of buyer and seller, both to exploit them directly and to change them by advertising. Lancaster explicitly assumes away these possibilities, and so assumes away a large amount of marketing.

WHAT CHARACTERISTICS SPACE?

Throughout Lancaster's analysis he assumes that there is a single characteristics space. The axes are labelled variously 'z' (defined as the quantity of characteristic 1) or "Characteristic 1" in 1971, "Characteristic A" in 1979. In many of the diagrams

the axes are not labelled. Without apparently noticing the fact, though, he uses very different characteristics spaces in different parts of the analysis. This is a potent source of confusion as, for reasons that will be discussed in Chapter 5 and 6, one can expect very different indifference surfaces and budget lines in different characteristics space. This is clear if one compares supply and preferences for chilli in a curry, chilli in a meal, chilli in ones diet and chilli in total consumption.

Some of the different characteristics spaces used by Lancaster are:
1.   Total amount of characteristic in total consumption. This requires the assumptions of linearity and additivity. It appears to be the characteristics space used for the basic paradigm case.
2.   Total amount of characteristic in the diet (1971, p.17).
3.   Total amount of characteristic in a single unit of a good. This is the space used for the automobile example (1971, pp.157-174).
4.   One axis being "Cleaning power per dollar" for goods in the product group detergent (1966, p.153). This conflates two characteristics and introduces concepts like value for money. It does not appear in Lancaster (1971).
5.   Level of characteristic obtained from one or more goods in one product group. This appears to be the characteristics space used for most of the analysis, including that which apparently uses the paradigm case.
6.   A space with a "normalized" efficiency frontier giving some sort of "normalized" level of characteristic possibly in one group of related goods. This is used in analysis derived from the second paradigm case.
7.   Characteristics per unit of a good (1979, p.28).

It should be noted that each characteristics space implies a different goods space.

The use of "Total of characteristic A in consumption" implies that consumers perceive the characteristic "Chilli" in their total diet even though the quantity is small and act to maximize it, which would be unrealistic for most characteristics.

It may be noted that changing the precision of definition may have similar effects on the shape of preference and supply curves. A characteristic could be defined as sweetness, sugar, fructose, "sugar in wine", "sugar in a bottle of wine" and so on.

Lancaster slips from one characteristics space to another without apparently knowing that he is doing so and without appreciating how it affects his analysis.

The matrices of consumption technology presented in Lancaster (1966) and Lancaster (1971) were introduced in order to show that if indifference curves are convex to the origin in (undefined) goods space, they will be of a similar shape in (undefined) characteristics space. They cannot be used to show that because indifference curves may be of one shape in the space of traditional indifference theory using goods, they will be of a similar shape in all characteristics spaces.

Further limitations in their interpretation will be identified in Chapter 5.

TWO-STAGE MODELS

The basic paradigm assumes that goods give rise directly to characteristics. It is however possible to assume that the "characteristics are derived from consumption activities in which goods, singly or in combination, are the inputs" (Lancaster, 1971, p.47). The two-stage model assumes that each activity is linear and requires goods in fixed proportions.

Lancaster (1971) does not give examples of this but it would appear to cover such activities as cooking a meal, where goods are processed by activities to produce characteristics which may not be in the component goods. Lancaster (1966, p.133) says:

> "A meal (treated as a single good) possesses nutritional characteristics but it also possesses aesthetic characteristics, and different meals will possess these characteristics in different relative proportions. Furthermore, a dinner party, a combination of two goods, a meal and a social setting, may possess nutritional, aesthetic and perhaps intellectual characteristics different from the combination obtainable from a meal and a social gathering consumed separately".

The implication of cannibalism appears to be unintentional. It will be noted that the "characteristics" produced in this 1966 statement do not conform with the criteria of linearity, additivity, objectivity, measurability and so on. Lancaster does not keep his strict assumptions when he moves to two stage models.

Lancaster states

> "there are now three spaces: goods space, activity space and characteristics space, instead of two. We could transform the problem into activity space . . . but shall find it convenient, as before, to continue to handle it in characteristics space. The analysis is not, in fact, much more difficult than the simpler model since we need only deal with activity space and characteristics space" (1971, p.48).

The remainder of Consumer Demand is equally applicable to either.

The concept that a mixture of goods may produce characteristics that are not in the original goods is clear enough. No doubt the relationship between goods, activities and characteristics could be described mathematically as Lancaster suggests. However, there must be some operational way of moving from the analysis of characteristics in the paradigm case to the goods if the theory is to be of any practical value. Lancaster does not discuss this. One may ask for instance what function would relate the contents of a market basket to all the possible meals that could be produced and their characteristics? How would this function be altered by

consideration of the people one might consume the meal with, what they might talk about and the locations in which one might eat - to use Lancaster's own example? How could one possibly determine this function with regard to even a single individual?

The assumption that all consumers see the same characteristics is even less credible when the goods are processed by some activity to produce goods than when the characteristics are contained in the goods. One's cooking, for instance, is very personal, and it is not to be expected that many people could produce identical meals from the same ingredients, much less an identical set of meals from the same market basket.[8]

In many cases, applying an activity to goods whose characteristics do meet Lancaster's assumptions will produce characteristics which certainly do not, like taste, texture, beauty and aroma.

Lancaster (1971) skips over this two stage model in two pages, while it is the basic model of Lancaster (1966). One may wonder whether this is a recognition that it is not handled satisfactorily. Ratchford (1975, p.66) suggests that this is so:

> "The complete model in Lancaster's original paper (1966) postulated an intermediate relation between goods and characteristics: goods are transformed into activities such as eating, swimming, transportation, which produce characteristics. This model proved difficult analytically and was abandoned in favour of the simpler framework presented here".

AGGREGATE SUPPLY AND DEMAND

The second paradigm case in Lancaster's theory is devised to deal with supply and demand in the aggregate. He argues that it is not possible to base any aggregation on the demand of a single representative consumer, as in traditional theory, for the situation is not approximated by a single customer buying different quantities of a single good at different incomes and prices. Rather it is one of different consumers each buying different goods and possibly changing the goods bought as price and income change. Accordingly, he argues that there should be at least one representative customer for each facet, vertex and edge of the basic paradigm case (1971, p.51). Each representative's decision should be weighted according to the

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[8]   Lancaster (1966, p135) assumes that each consumption activity, that is each good or collection of goods, including a market basket, produces only a single fixed vector of characteristics, so there is only one set of meals that can be consumed from a given market basket.

amount of money spent.

He argues that the efficiency frontiers for customers with different incomes will be geometrically similar - of the same shape. This depends on the assumptions discussed above, notably that consumers face the same prices, that prices are linear and that consumers share the same consumption technology, as well as the assumptions on preferences. This implies inter alia that there is perfect information on prices and characteristics and all consumers perceive the same characteristics.

The individual preferences and efficiency frontiers are first plotted as in the basic paradigm case. This diagram is then expanded or shrunk, until the efficiency frontiers match those for some convenient unit income. Because they are of the same shape, they will tally exactly. The shape of the indifference curve remains as it actually is, rather than being the shape it would be if the consumer got unit income. This is shown in Figure 2.7 (Figure 4.1 in Lancaster 1971). Here

> "I_{21} and I_{22} identify the indifference curves which consumer II can attain with incomes 1 and 2 respectively. In Figure [2.7] the efficiency surface is normalized for unit income" (1971, p.52).

For aggregation, each observation would be given a "market weight" depending on the amount spent at that point: "it does not matter whether this is derived from a large number of identical consumers with low incomes or a small number of consumers with high incomes" (1971, p.53). The market weight applies to a single point and indeed it may be argued that if two differently shaped indifference curves happen to touch the same point, each will have its own weighting, which would introduce complexities not discussed by Lancaster.

The diagram does not give any indication of market weighting or of the quantity purchased by any individual. It indicates only that a representative consumer does or does not buy a good. Lancaster's exposition is obscured by the fact that he fails to make this point.

It will be noted that the axes in the diagram were not labelled by Lancaster and in the rest of his chapter they are labelled "Characteristic 1" and "Characteristic 2". Initially, he appears to be thinking in terms of characteristics in total consumption (though this is not so clear elsewhere in the chapter). The enlarging and shrinking procedure means that this is no longer so. If the axes were at least labelled "Normalized quantity of characteristic A in an individual's total consumption" there would be some indication that the analysis is proceeding in a completely different space to the basic paradigm case. The fact that the first and second paradigm cases look so similar when they are in completely different spaces is a potential source of confusion.

EXTENSIONS AND MODIFICATIONS

In Chapter 6 of <u>Consumer Demand</u> Lancaster considers some extensions and modifications to the basic theory.

NEGATIVE CHARACTERISTICS

A characteristic that is universally perceived as being negative can be dealt with by plotting it negatively, but this is not possible if some people react to a characteristic positively, some negatively. In this case Lancaster accepts that his conclusions on efficiency substitution and efficiency choice derived from the second paradigm no longer hold (Lancaster, 1971, p.97).

He sets out the negative indifference curves as shown in Figure 2.8. (Figure 6.2 in Lancaster 1971). Throughout this chapter it is not stated which characteristic space he is operating in, but it would appear to be that of Paradigm Two. The optimizing position is shown in Figure 2.9 (Lancaster's Figure 6.3). Lancaster believes that the optimizing position for someone who values the characteristic negatively must be tangential to the efficiency frontier. The efficiency frontier is defined as giving the most of both characteristics for a given sum of money. It is therefore only optimal when both characteristics are positively valued. The definition means that options that give the same amount of characteristic A and less of characteristic B do not appear on the frontier, though this is clearly what the consumer who dislikes characteristic B would like.[9] Chapters 5 and 6 of this refutation show that this is of major importance.

Lancaster does not consider the situation where characteristics may be valued positively at one level, negatively at another.

ADDITIVITY

The development of the paradigm case depends on the assumption of additivity, that characteristics in two or more goods can be added. At a late stage this assumption is

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[9] The shape and slope of the indifference curves in Figure 2.8a is arbitrary, and different slopes are possible: for example if one unit z_2 counteracts one unit z_1, the curve is a straight line through the origin at 45°. Similarly, in Figure 2.9 OG_3 could be at a greater angle to OZ_1. Then, if the price of G_3 fell until the quantity that could be purchased was E, the indifference curve would be tangential to it at some point like F. This means that a quantity smaller than the feasible amount would be purchased.

dismissed as unnecessary in a single sentence.

> "If two goods, consumed together in particular proportions, give rise to a vector of characteristics which is not the sum of the vectors of characteristics of the separate goods, we simply regard the goods combination as an activity which uses goods as inputs and produces characteristics as outputs" (1971, p. 107).

This cannot be read as saying that if steak and chips, which both contain protein, vitamins and calories, are consumed together, one can plot an indifference surface on a graph with quantity of steak in total consumption and quantity of chips in total consumption as axes (or quantity on the plate or in the meal). Unlike Lancaster's approach, such an approach would make no use of characteristics, but would have goods as the axes. Unlike Lancaster's approach, it would not produce a quantifiable characteristic, merely a combination that is valued subjectively - and on the same page Lancaster reemphasizes that "it is of the essence of the analysis presented here that the characteristics are technically and universally related to the goods" (1971, p.107).

Lancaster states rather than an intermediate characteristic is produced. There is a different characteristic for each combination of steak and chips, two parts steak to one part chips, one part steak to one part chips and so on, implying an infinite number of characteristics. Each of these characteristics can be an axis for the paradigm cases mapped in some characteristics space. Lancaster is explicit that there is not one characteristic "steak and chipness" produced, which can be applied to all combinations. This approach requires an infinite number of characteristics for steak and chips alone. Every combination of goods produces a unique characteristic. Clearly this is of no practical application - Lancaster himself feels that in practice there should be fewer characteristics than goods, as in his automobile example.

NON-LINEARITY

When Lancaster discusses the possibility of dropping the assumption of linearity, he emphasizes first that many apparent cases of non-linearity are due to taking non-linear subjective evaluations for objective linear effects. However, he does state "There is always some subtlety of interpretation required in determining relevant characteristics" (1971, p.108) and this leads him to statements like "Obviously, an automobile is either a Plymouth Ferry or it is not, but what are the characteristics which arise as a consequence of its being one particular model of automobile?" (1971, p.108). Both here and in the automobile example of his Chapter 10, he is either using purely subjective attributes as objective characteristics, which he criticizes as an error when others do it, or he is using his own perceptions rather than those of consumers to determine how his characteristics should be defined, contrary to his assumptions. This does not suggest that other people using his theory are likely to apply it correctly.

Lancaster considers non-linearity only in the form of integer characteristics and concludes that they limit the application of his theory.

AD HOC ASSUMPTIONS

The further development of the theory depends on the introduction of ad hoc assumptions. The paradigm case depended on boundary assumptions which limited the application to certain areas of reality and to fundamental assumptions which were assumed to be universally true. There were also assumptions like perfect knowledge, which are ad hoc: they are clearly unrealistic in nearly all markets and they were put in purely because the theory could not proceed with more realistic assumptions. In this section some of the ad hoc assumptions which had to be introduced to develop the theory beyond the second paradigm case are identified. These are set out in more detail in the next chapter.

Several questions should be asked regarding any of these:
1.	Does it make the model more realistic?
2.	Does the assumption apply in any real life situation whatsoever?
3.	Does it apply to all consumers, all goods and all characteristics?
4.	Is it (a) possible, (b) practical to identify whether the assumption holds in any real life situation?

Some of the ad hoc assumptions made are as follows:

"Preferences should be expressible in simple functional form" (Lancaster, 1971, p.72).

"The functional form should be the same for all individuals . . ." (Lancaster, 1971, p.72).

The Cobb Douglas functional form is assumed (Lancaster, 1971, p.73).

"Uniform distribution is assumed so that average income is constant . . ." (Lancaster, 1971, p.79).

A rectangular distribution of preferences is assumed. (Lancaster, 1971, p.79).

Goods are completely separable, sharing no characteristics. (Lancaster, 1971, p.126).

Private substitution effects are greater within a group than across

groups and overall substitution effects are noticeably higher within groups (Lancaster, 1971, p.127).

"The prices of other relevant parameters for goods outside the group remain constant" (Lancaster, 1971, p.128). This is a ceteris paribus assumption which is not relaxed. It is implicitly assumed that changes in the price of non-group goods and group goods are independent of each other (what about apples and oranges, cars and petrol?)

"The group can be analysed in isolation . . ." (Lancaster, 1971, p.128).

All other goods may be treated as identical, all being equally close or distant substitutes for this group (Lancaster, 1971, pp.128-9).

The group has (a) characteristics possessed only by goods in the group and (b) characteristics possessed by all or nearly all other goods, but not (c) characteristics possessed by some other goods. (Lancaster, 1971, p.132).

There is a single universal characteristic (Lancaster, 1971, p.134).

It is implied that there is only one group (Lancaster, 1971, p.133).

The required quantity of universal characteristic could be obtained by expenditure on goods entirely outside the group (Lancaster, 1971, p.135).

"The required quantity of universal characteristic could not be (or could only just be) obtained by expenditure entirely within the group" (Lancaster, 1971, p.135-6).

The ratio between market prices and adjusted prices is the same for all goods in the group (Lancaster, 1971, p.137).

The cost of obtaining each of the universal characteristics is the same for all goods in the group. (Lancaster, 1971, p.138).

Every good in the group possesses the various universal characteristics in the same proportion. (Lancaster, 1971, p.138).

The analysis ignores characteristics that are not "relevant" (Lancaster, 1971, p.140).

"Universal characteristics are irrelevant to the small group" (Lancaster, 1971, p.141).

"A characteristic is totally irrelevant if it does not appear in consumers' preference functions" (Lancaster, 1971, p.146).

"A universal characteristic is irrelevant to the group if the contents of this characteristic, per dollar spent, is approximately uniform over goods in this group" (Lancaster, 1971, p.141).

"A characteristic which is invariant over the group is irrelevant" (Lancaster, 1971, p.142).

It is assumed that technology is linear (Lancaster, 1971, p.142) and that consumers react accordingly (Lancaster, 1971, p.144).

If two or more characteristics are possessed by all goods in fixed ratio to one another, we can treat all but one of them as irrelevant (Lancaster, 1971, p.144).

A characteristic may be treated as irrelevant if it does not appear in the preferences of a large proportion of the consumer population or if it has a low weight in preferences (Lancaster, 1971, p.146). This would appear to mean that minority tastes can be ignored, that we can ignore the fact that 20% of the population hate garlic. It is not clear why one would wish to have a model of quality in consumer demand that ignores such factors.

An individual's welfare function depends only on his or her own consumption and there are no consumption externalities such as the pleasure they get from seeing that other people get the quality they want (Lancaster, 1979, p.11-12).

There are economies of scale in the production of large quantities of a product to any single specification (Lancaster, 1979, p.12).

The economies of scale are specific to a particular product variant (Lancaster, 1979, p.12).

All economies of scale are made use of (Lancaster, 1979, p.12).

Goods can be produced to any specification (Lancaster, 1979, p.12).

"The most heroic assumption is the <u>uniformity assumption</u> 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).

Lancaster (1979) takes some of the highly specific conclusions from Lancaster (1971) such as those on groups, which required sixteen new <u>ad hoc</u> assumptions, and assumes them to be generally true.

Each <u>ad hoc</u> assumption reduces the number of cases that the theory can be applied to, and the cumulative effect is to make it doubtful whether the theory can apply to any real situation. They are introduced because Lancaster, who strives for rigour, thinks that the theoretical analysis cannot proceed without them.

THE AUTOMOBILE EXAMPLE

Lancaster's automobile example is of particular interest as it is the only substantial example he produces, and is one of only two practical examples in the book <u>Consumer Demand</u>. Virtually none of the assumptions made elsewhere in the book hold here.

-        Someone buys one automobile and only one. He or she cannot get a mix of characteristics by combining two cars. The efficiency frontier must be a series of points.

-        The purchase is unlikely to be on the budget line: if the preferred car costs less than the budget would indicate, less is spent.

-        The characteristics are assumed to be:
              - accommodation (size and comfort of seating etc.)
              - ride qualities
              - handling and steering
              - engine (quietness and performance)
              - brakes
              - frequency of repair record (based on model of previous   year)
              - manufacturer's suggested price.
      These characteristics are not linear, additive, objectively measurable or objective.

-        The analysis is not in the space "level of characteristic in total

consumption".

- The attributes used are based on what a Consumers' Union reporter thinks subscribers would think of the cars.

- Price is treated as a characteristic.

- Brand is not treated as a characteristic.

- Information is not perfect. Price and quality information is poor in the USA and advertising expenditures are high.

Since the assumptions of the theory bear no relation to the market discussed, the automobile market is neither an example nor a test of the theory: it is irrelevant. It may be wondered if this is an indication that Lancaster was unable to come up with an example where his assumptions did hold.

LANCASTER FOUR

In Lancaster Four (Variety, Equity and Efficiency) some of the assumptions made are not compatible with those of the paradigm cases, and in particular where there is no combinability, additivity or linearity (e.g. Lancaster, 1979, p.24). Nevertheless, he incorporates into his model most of the theory of Lancaster One and Two which is based firmly on these assumptions. Similarly, in Lancaster Two a large number of ad hoc assumptions were introduced to justify his formalization of the idea of a group. The result was a fragile model built on special cases. In Lancaster Four he takes this model as being generally applicable (1979, p.24).

Generally the analysis in Lancaster Four depends on a lot more ad hoc assumptions than the basic paradigm cases.

CONCLUSIONS

This chapter set out the framework of Lancaster's theory, showing how different types of assumptions are brought together to produce the two paradigm cases, and then showing how new assumptions are brought in to develop the theory from there. This chapter will be followed by Chapter Three setting out Lancaster's theory in detail.

BOUNDARY ASSUMPTIONS

The chapter starts by showing that the theory has very restrictive boundary assumptions, which have the function of limiting analysis to a small subset of reality. These include:

- Assumptions on perception and reaction; that for example people all see the same characteristics.

- Assumptions on qualitative and objectively measurable characteristics.

- The linearity assumption.

- The additivity assumptions.

- Assumptions facilitating comparisons between individuals.

While it appears to be possible that there are some situations in which these conditions might conceivably hold, no evidence was produced by Lancaster to demonstrate that any such situation does exist. More seriously, perhaps, no way was suggested of determining whether the boundary assumptions did in fact hold in any particular case: how would one determine that all consumers have the same perception of price and characteristics? that they perceived characteristics linearly and additively? If it is possible to determine this, it requires the techniques of other approaches like behavioural or psychological approaches, which are expensive and time consuming, and this negates the apparent advantage of Lancaster, in working with easily measurable objective characteristics at low cost. If it is not possible to determine this, there is no way of determining whether the theory does or does not apply in any case, and the theory has no practical application.

FUNDAMENTAL ASSUMPTIONS

There are also fundamental assumptions which Lancaster appears to believe are broadly true in most situations, not just those where his boundary assumptions hold. These include

- Assumptions on what people value and what choices are based on, such as that choices are made on characteristics.

- Assumptions on preferences.

- Assumptions on the product and its prices.

41

Again, Lancaster does not suggest how one might determine whether the assumptions did apply in any particular case, but this is justifiable if the assumptions are generally true. However, in Chapters 5, 6, 7 and 8 of this refutation it will be argued that they are very rarely true and there is no possible way of identifying the very rare cases where the assumptions may apply.

PARADIGM CASES

Lancaster's two paradigm cases are developed from these assumptions. His rigour is such that each of his assumptions is necessary to the theory. One very important implication of this is that it is not possible to drop one of these assumptions or change it without changing all the logic that leads to the paradigm cases and all the theory developed from them. If the first step is altered, the whole superstructure built on it must be altered.

The paradigm cases are clearly restricted to product differentiation and the more general product variation is excluded.

WHAT CHARACTERISTICS SPACE?

Lancaster slips from one characteristics space to another without noticing it, and without realizing that the shape of a preference function or a budget constraint depends very much on the space in which it is plotted.

This throws much of his analysis into question, as will be shown in chapters 5 and 6.

TWO STAGE MODELS

A two-stage model is introduced to handle cases where the characteristics consumed are not those of the goods consumed. It adds little to the theory.

EXTENSIONS AND MODIFICATIONS

Lancaster's handling of negative characteristics is confined to situations where characteristics are perceived to be undesirable at all levels, and is incorrect. His dropping of his additivity assumption makes his theory unworkable, and his dropping of his linearity assumption requires major changes in the paradigm cases, which mean his general conclusions no longer apply.

AD HOC ASSUMPTIONS

The development of the theory after the paradigm cases requires a long string of <u>ad hoc</u> assumptions. It is extremely doubtful that there is any real life situation where these <u>and</u> the boundary assumptions <u>and</u> the fundamental assumptions hold. Again, it does not appear to be possible to determine if they hold in a particular situation. If the analysis based on the <u>ad hoc</u> assumptions is dropped and Lancaster's theory is judged purely on its paradigm cases, what remains is a much stronger theory.

THE AUTOMOBILE EXAMPLE

The automobile example is the only example making use of the paradigm cases (the only other practical example in <u>Consumer Demand</u> uses the example of protein, calories and vitamins in the different foods that make up a diet, to demonstrate linearity and additivity). However, the example is of a situation where very few of the assumptions of the paradigm cases hold, so Lancaster's theory is inapplicable. The question arises "Why did he choose this example? Was it because he could not find any situations where his assumptions did hold?"

SUMMARY OF CHARACTERISTICS THEORY

In the last chapter the broad framework of Lancaster's theory was set out, drawing attention to areas of concern. In this chapter the theory is set out, closely following Lancaster's own exposition, so that these areas of concern can be examined in context.

LANCASTER ONE

In this Section, I summarize the argument of the first half of Consumer Demand: A New Approach (Lancaster, 1971). In the summary I shall keep to his system of numbering and headings, for easy reference. The numbering of the assumptions he makes has been introduced for the purposes of this refutation. The argument in Lancaster 1966 has been included in Lancaster 1971, which may be taken to be a fuller, more rigorous, statement of the argument.

Scope of This Study

He sets out the aim of Consumer Demand as being

"to develop the implications of the simplest characteristics model (the linear model) for static demand theory and to lay the foundations for operational application in this area." (Lancaster, 1971 p11)

His objective is to set out in Part 1 of the book (Chapters 2-7)

-        "The basic development of the characteristics approach largely in terms of a
         linear technology,"

-        "that there are efficiency effects common to all consumers as well as demand
         effects which depend on individual preferences,"

-        "that aggregate behaviour cannot be expressed in terms of the traditional
         'representative consumer' because different groups of consumers will react
         only to different groups of goods if their price changes",

-        "to explore simple models of distributed preferences",

-        "that something can be said about substitutability between goods on the basis of objective technical data alone." (Lancaster, 1971, p11)

1. INTRODUCTION
1.2 Traditional Demand Theory

Lancaster starts with a description of traditional demand theory, using indifference curves between two goods. Throughout the book he uses "traditional" to refer to demand where different goods are considered, rather than the older traditions of quality analysis, such as Waugh's (1928) characteristics approach.

1.3 Giving Goods Their Due.

Assumption 1.1   He bases his analysis on the assumption that each good has characteristics, "those objective properties of things that are relevant to choice by people" (Lancaster, 1971 p6). (Objective properties that do not influence choice are not characteristics in his terminology.)

> "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 the goods." (Lancaster, 1971 p6)

The basic assumptions on which the analysis in the book is based are:

Assumption 1.2

> "The relationship between a given quantity of a good (or a collection of goods) and the characteristics which it possesses is essentially a technical relationship, depending on the objective properties of the goods and, sometimes, a context of technological 'know-how' as to what the goods can do, and how." (Lancaster, 1971 p7)

Assumption 1.3

> "Individuals differ in their reactions to different characteristics, rather than in their assessment of the characteristics contents of various goods collections. This is the working hypothesis of the book. It is clearly not applicable to all cases. People may sometimes appear to 'see' properties of a good that are not seen by others and defy objective analysis. Our interest here is in the addition to both analytical understanding and potential predictive power of cases in which the characteristics approach seems to fit. At worst, we fall back on the traditional analysis by assuming that the consumption technology is unknown in practice for some groups of goods."

(Lancaster, 1971 p7) " . . . preferences for goods are <u>indirect</u> or <u>derived</u> in the sense that goods are required only in order to produce the characteristics." (Lancaster, 1971 p7)

There is, therefore, a distinction between
" . . . the relationship between things and their characteristics (objective and technical) and the relationship between characteristics and people (personal, involving individual preferences)". (Lancaster, 1971 p7)

<u>Assumption 1.4</u>: He <u>assumes</u> that
" the characteristics-people relationship is of the same kind as the goods-people relationship assumed in traditional theory, that is, that people have well-defined preferences for collections of characteristics, expressible in terms of preference maps with indifference curves convex toward the origin. We shall, however, see that some aspects of preference relationships, such as satiation phenomena, call for more detailed analysis than is given in the traditional case." (Lancaster, 1971 p7-8)

In effect, he is <u>assuming</u> that he can use the two-good indifference theory analysis of traditional demand theory as the basis for multi-characteristic analysis of one or more goods. (See below, assumptions 2.10 to 2.15 for more details of the assumption)

<u>Assumption 1.5</u>: At some times Lancaster appears to be assuming that there is a single product consumed, which is composed of all the characteristics of its ingredients, as the nutrition of pigfeed is the sum of the protein, fat, vitamins etc. of its component foods. This is a reasonable interpretation, when he states that his model grew up out of production economics models, which are concerned with the optimum mix of raw materials like the ingredients of a chicken feed mix. At other times he appears to be talking of a situation where the characteristics can be obtained from any goods whatsoever. A consumer gets the same subjective satisfaction from protein provided in the form of steak, potatoes, or, if one takes the assumption literally, shoe leather. (e.g. "The consumption technology is, in principle, a statement of the whole consumers' world, that is, of the relationship between all goods available in the economy and all characteristics to which any consumer has any reaction." (Lancaster, 1971 p125)) He is seldom explicit about which assumption he is making.

1.4 Why
"The demand for a new good could, in principle, be predicted from observed behaviour with respect to existing goods, provided the new good possesses the same characteristics (although in a different

combination) as those existing. Whether goods are close substitutes
or not is shown to depend (as expected) on their characteristics, and,
in principle, the closeness of substitution could be predicted from
technical data concerning characteristics" (Lancaster, 1971 p10-11)

2. THE BASIC REFERENCE MODEL

2.1 The Consumption Technology

The "Consumption Technology" is Lancaster's terminology for the relationship
between goods and characteristics: what characteristics can be obtained from a given
mix of goods. The basic characteristics model used is based on a linear additive
relationship between goods and characteristics. The model is based on the following
assumptions:

Assumption 2.1: "We assume at the outset, in this model, that all characteristics are
quantitative and objectively measurable" (Lancaster, 1971 p15)

Assumption 2.2: "Linearity . . . that the quantity x_i of the x_ith good possesses x_i
times as much of each characteristic as does unit quantity of that good." (Lancaster,
1971 p15). That is to say, ten units of a good have ten times as much of each
characteristic as one unit has.

Assumption 2.3: "Additivity . . . given quantities of the two goods x_j and x_k, the total
amount of the ith characteristic possessed by the goods collection (x_j,x_k) is the sum
of the amounts of the characteristic possessed by $x_j, x_k,$ separately". (Lancaster, 1971
p15). This would fit the sugar content, in grammes, but not the sugar content
expressed as a percentage, nor sweetness. This may be compared with his previous
statement: "The 'unit' in which a particular characteristic is measured is
unimportant except that it must be the same for all goods possessing the
characteristic and maintained throughout the analysis." (Lancaster, 1971 p15)

The characteristics collection is the sum of the characteristics that can be obtained
from a set of purchases. This is a straight linear sum of the characteristics of each
good. It is expressed in terms of a consumption technology matrix, which is,
perhaps, most easily visualized in terms of the linear programming models for inputs
which were already well established in agriculture at the time Lancaster wrote.
These had the object of getting a given mix of characteristics (e.g. the protein,
calories, vitamins, and fats in pigfeed) at the least cost, from a mix of raw materials.
The characteristics collection is the quantity of protein, calories, vitamins, etc. in the
pigfeed. For many such products it does not matter which raw material provides the
calories, fats, etc., and simple additivity of the characteristics in the raw materials
may be assumed. Lancaster was reformulating this model into one where a
consumer bought and mixed different products and the resulting mix was the
evaluated on component characteristics: he uses the example of someone evaluating
a diet consisting of milk, eggs, sirloin steak, oranges, bread etc., and valuing it only

for the characteristics it contains, calories, protein, vitamin A, etc.. (Lancaster, 1971 pp16-17).[10]   The problem is then one of getting the mixture of objective characteristics that gives the greatest subjective satisfaction at the least cost.

The concept of someone getting the same objective characteristic from two different goods, and indeed adding the characteristics linearly, was not widely used in marketing theory at the time, but it had been postulated.[11]

The characteristics collection from a given mix of products can be given by a general rectangular matrix with n number of goods and r the number of characteristics. This gives a consumption technology matrix B as follows:

Table 2.1 A Diet Example

Goods	Milk	Eggs (1/2 pt)(1)	Steak	Oranges (3oz.) (1)	Bread 1 loaf)	
Characteristics						
Calories (no)	160	80	330	60	1225	
Protein (mg)	9	6	20	2	39	
Vitamin A (IU)	350	590	50	240	...	

Source: (Lancaster, 1971 p17)

This matrix shows a change from goods space (i.e. milk, eggs etc.) to characteristics space (ie: calories, protein etc.), describing a basket as a mix of characteristics rather than a mix of goods.

Assumption 2.4: It is assumed here that " . . . in principle, the B matrix represents the whole consumption technology, so that it covers all goods and all characteristics relevant to the society (or sub-society) under consideration" (Lancaster, 1971 p18). It will be noted that at this stage Lancaster is talking of the society, not the individual, and assuming that everyone at least recognizes the same characteristics.

Assumption 2.5: It is assumed at this stage "that all characteristics are measured as

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[10]   This example has problems which do not arise with pigfood, which is eaten as a mixed product, and for which considerations like taste, texture and appearance are not relevant. The question of whether there are in fact consumer products which are reasonable approximations to his model remain unanswered.

[11]   Lancaster acknowledges his debt to production economics models including Stigler (1945). Gorman (1976) is a reprint of his 1956 paper presented in Iowa State College of Agriculture and the Mechanic Arts, and in 1956 he said "the underlying ideas, of course, have been known to me for many years, as, I imagine, they must have been to many economists." This is the earliest example I know of where the analysis was used in an explicitly marketing context.

essentially non-negative quantities and that goods are also essentially non-negative. . . . This ensures that our tabulation of the technology does not include any good which has none of the relevant characteristics or any characteristic which is not possessed by at least one of the goods." (Lancaster, 1971 p18). This is addressed in part in his chapter 6.

Assumption 2.6: "Finally, the assumption of universality and objectivity should be stressed. Every person in the economy is assumed to 'see' the same consumption technology just as, in basic production theory, every producer sees the same production technology. Whatever differences exist between persons as to how they view a given collection of characteristics with respect to themselves, it is assumed there is no difference between them as to what collection of characteristics is associated with any specified collection of goods." (Lancaster, 1971 p18) The assumption, therefore, is that everybody has an identical consumption technology. That is to say they each get the identical characteristics, in identical quantities, from any mix of goods. They may value them differently, but the identical set of characteristics is valued by each consumer.

Assumption 2.7: There is an implicit assumption here of perfect knowledge about what characteristics a given product mix can produce (or at least that all consumers share the same misperceptions in knowledge) and that each consumer knows what satisfactions a given mix of characteristics will produce for him or her.

2.2 The Traditional Analysis as a Special Case
He presents the traditional analysis of consumer behaviour (i.e. goods only) as a special case of the matrix, where each good has only a single characteristic. For example, butter has only butterness.

2.3 Preferences
The consumption technology discussed above considered the relationship between a mix of goods and their characteristics. The next step is to examine people's preferences for characteristics.

Assumption 2.8: "We assume that the interest of consumers is in characteristics, not in goods per se. . . Any preferences concerning collections of goods are derived preferences, a particular goods collection being preferred over another only because the collection of characteristics associated with the former is preferred to the collection of characteristics associated with the latter" (Lancaster, 1971 p20)

Assumption 2.9: An implicit assumption of great importance is that there is no quiddity, that a steak is not a steak with certain characteristics, but is a mixture of characteristics, a mixture which can be obtained in different ways, through mixtures of other goods having relevant characteristics, like protein and vitamins (though whether texture can be included as a characteristic is doubtful: taste certainly cannot)

Assumption 2.10: Lancaster assumes without explanation the whole preference system to be used: "At this stage we do not wish to investigate the structure of preferences but will simply carry over traditional preference theory, applying it to collections of characteristics instead of to collections of goods. The assumptions of traditional preference theory modified for our use are:" (Lancaster, 1971 p20).

[Assumption 2.11]
       (1) "The consumer has a complete quasi-ordering over the set of all characteristics collections" This requires
            (a) transitivity,
            (b) completeness,
[Assumption 2.12]
       (2) Continuity,
[Assumption 2.13]
       (3) Strict convexity,
[Assumption 2.14]
       (4) Non satiation,
[Assumption 2.15]
       (5) All characteristics positively desired
[Assumption 2.16]
       (6) The consumer acts in accordance with his preferences.

These assumptions apply to each individual consumer.

The stated purpose of assumptions (1), (2) and (3) is "In other words, these three assumptions enable us to summarize the consumer's preferences in terms of a utility function whose contours (indifference curves) are strictly convex toward the origin." (Lancaster, 1971 p20). Assumptions (4) and (5) are added to "guarantee that the consumer's preferences can be expressed in terms of an ordinal utility function of the neoclassical kind with all its first-order partial derivatives positive." (Lancaster, 1971 p21). In other words these assumptions have been made to get indifference curves that can be analysed using established neoclassical theory, not, for instance, to simplify the models by removing unimportant factors while retaining those that are important.

2.4 Choice with a Budget Constraint
The distinction that Lancaster observes between his model and traditional models that deal with goods only, is that his model attempts to optimize the characteristics mix chosen rather than the goods chosen. The objective function is defined in characteristics space, and the feasible set by what goods can be bought, in what combinations. The utility function could be mapped in goods space, but Lancaster prefers not to do this, mainly because each map including the consumption technology would be specific to the individual: "The properties from the technology

(which apply to all consumers in a class) and those from the personal eccentricities of the individual, become extremely difficult to disentangle once the utility function has been mapped into goods space." (Lancaster, 1971 p23)

His conclusion that "the one mapping will suffice for all customers facing the same market conditions" (Lancaster, 1971 p24) relies on the assumptions that

Assumption 2.17:
      "For consumers facing the same market conditions, the individual budget constraints . . . differ only in the value of . . . the income.

[Assumption 2.18:] "The goods-characteristics relationship . . . is the same for all consumers.

[Assumption 2.19:]
"This relationship is also linear . . . This means that the feasible sets (in characteristics space) of different consumers are simply related by scalar expansion or contraction in proportion to the ratios of their incomes" (Lancaster, 1971 p24)

Assumption 2.20: There is a strong implicit assumption here on pricing. It is implied that the consumer is buying a set of goods, all with positive prices.

Assumption 2.21: There is also an implicit assumption that the production technology is such that one can make a continuous shift in level of characteristic. One does not have to jump from a 1300cc engine to a 1500cc engine.

Assumption 2.22:
There is a partially explicit assumption that all consumers face the same market conditions (Lancaster 1971 p24).

3. ANALYSIS IN CHARACTERISTICS SPACE

3.3 Efficient Choice
The efficiency set or efficiency frontier is a set of the outer boundaries of the feasible set in characteristics space. Lancaster states, "It follows from basic optimizing theory that the optimum point is necessarily a boundary point . . ., interior solutions being ruled out" (Lancaster, 1971 p35). That is to say, all potential optimum points lie on the outer boundary of what characteristics it is possible to buy with a given budget. He states that this depends on the assumption that all characteristics are positively desired. In fact, while the feasible set is objective, the efficiency set or efficiency frontier is not: it is determined in part by subjective utility, though Lancaster himself does not see this point.

3.5 Classification of Optima

Lancaster's optimum characteristics collection is one which (a) is on the efficiency frontier in C-space, and (b) maximizes utility. The existence of an optimum, and hence of an efficiency frontier, requires the existence of a utility function. The utility function which was assumed, without any attempt at justification, was one which he said he would "simply carry over from traditional preference theory" (Lancaster, 1971 p20). Thus for the efficiency frontier he states "For a regular utility function of the kind assumed, an optimal point . . . will lie on the highest contour (indifference surface) which is attainable." (Lancaster, 1971 p38). He goes on to say that the optimum must lie

1   "in the interior of a facet, in which case the indifference surface . . . must be tangent to the facet in every direction . . .

2   "in the interior of an edge . . . in which case the indifference surface . . . must be tangent to the edge . . .

or 3   "on a vertex, in which case no tangency conditions need to be met
Proof of these propositions is trivial, along the standard lines of elementary economics" (Lancaster, 1971 p38). See Figure 3.6 from (Lancaster, 1971 p 39) which is the same as Figure 2.6 in this book.

In effect, he assumes an indifference surface like that in simple, two-good, demand analysis. This is a matter of assumption.

3.9 Two-Stage Models

Assumption 3.1: " The analysis so far has been concerned with the simplest linear model in which goods are assumed to give rise directly to characteristics. The model can be given greatly increased adaptability by assuming that characteristics are derived from <u>consumption activities,</u> in which goods, singly or in combination, are the inputs." ". . . activities, not goods directly, give rise to characteristics" (Lancaster, 1971 p47)

Assumption 3.2: "Each activity is assumed to be linear and to require goods in fixed proportions . . . "(Lancaster, 1971 p47)

"The simple model can be regarded as simply the special case where each activity uses only one good and each good is used in only one activity" (Lancaster, 1971 p 48-9)

4. DEMAND THEORY

4.1 End of the Representative Consumer

Lancaster says that under his theory it is not possible to aggregate from a single representative consumer, as in traditional demand theory (goods only). Instead we need representatives of the consumers who make each choice:

"To describe total market demand we need, therefore, more than one representative consumer, at least one for every facet, vertex and edge. Obviously, a consumer who chooses a point on one facet has, in some quite definite sense, different preferences from a consumer who chooses a point on another facet (or vertex or edge) under the same budget constraint. The relative demands for goods relevant to different facets will, therefore, depend on the relative purchasing powers of the consumers whose preferences lead to choice on the facets in question. . . . Aggregate demand cannot be analysed without considering the distribution of preferences in relation to the distribution of income." (Lancaster, 1971 p51)

4.2 The Representative Efficiency Frontier

"Although we cannot use a single representative consumer in our demand analysis, we can use a single representative efficiency frontier so long as there is a linear consumption technology. Since the budget constraint on goods is linear, and the transformation from G-space to C-space is linear in this case, the efficiency frontiers for consumers with different incomes but facing the same prices will be geometrically similar and related by homogeneous expansion or contraction." (Lancaster, 1971 pp 51-2).

In effect he is saying that one can use an enlarger to expand or contract one person's efficiency frontier to produce anyone else's. This depends directly from his assumptions, not only those he mentions here, but also those on the shape of the indifference curve: transitivity, completeness, continuity, strict convexity, non satiation, all characteristics positively desired, and the consumer acts in accordance with his preferences (Assumptions 2.10 to 2.16). Since the efficiency frontier has a subjective element, it is necessary to make assumptions which prevent different people from having subjective perceptions which do not permit this assumption. It also requires the assumptions he does not mention here about which characteristics are included (Assumption 2.6).

Assumption 4.1: This implicitly assumes away much marketing, such as differences in prices paid by different people.

From this he concludes that, for aggregation, "in analyzing aggregate demand in terms of a representative efficiency frontier, the relevant parameter associated with each indifference curve passing through a chosen point is simply its market weight. It does not matter whether this is derived from a large number of identical consumers with low incomes or a small number of identical consumers with high incomes." (Lancaster, 1971 p53)

In effect, it is assumed that each individual has the same shape of efficiency frontier. This is only possible if all the assumptions are strictly correct

- on what characteristics are included
- on consumption technologies
- on everybody sharing the same consumption technologies
- on the properties of indifference curves
- on people facing the same prices and markets
- on the lack of any market effect.

4.3 Efficiency Substitution

Lancaster gives an example of five goods, each having different proportions of the same characteristics, one of whose prices change from an initial point where no rational consumer would buy it as they could get more of at least one characteristic for the same outlay by buying another product (i.e. a positive value of the characteristic is assumed). As the price falls, it moves the efficiency frontier, so that first it could be a rational choice and then, as it becomes cheaper still, it becomes the only rational choice. This price change "involves substitution of a good or a combination of goods for a particular good. This substitution is universal since it depends on the criterion of efficiency only, and does not depend in any way on the nature of individual preferences. We shall refer to this effect as the efficiency substitution effect." (Lancaster, 1971 p57)

This substitution is, of course, "universal" only within the carefully specified assumptions. It applies to the universe of people with identical consumption technologies and with the assumed preference functions.

"We can prove formally that the efficiency substitution effect is sufficient to guarantee the convexity of demand on which the existence and stability of competitive equilibrium depend, although only in the weak sense. Nevertheless, this is an important result since the nature of the effect makes it completely independent of income distribution and of the convexity of individual preferences." (Lancaster, 1971 p58)

4.4 Personal Substitution

The personal substitution effect is seen as being analogous to substitution in two (or more) good indifference theory. It depends on personal preferences. "Broadly speaking, the extent of the personal substitution depends on (i) whether the consumer's initial choice was on a facet, edge or vertex; (ii) whether the price change is in a good relevant to the consumer's chosen point; and (iii) the convexity of the consumer's preferences)" (Lancaster, 1971 p60). "If the indifference curves have the traditional smooth convexity, as drawn, there will be substitution effects, precisely analogous to those of the traditional analysis for consumers II and III. These can be separated in the usual way from the income effects which arise because the efficiency frontier has been pushed forward. . . . For strict vertex consumers, illustrated in Figure 4.6 [Figure 3.1 in this refutation], there would be zero personal substitution effect for a very small change in the price of G_3. Nor would there be a personal substitution effect for a consumer who chose characteristics in fixed

proportions (point indifference curves)" (Lancaster, 1971 p61). "The personal and efficiency effects cannot counteract each other, but work in the same direction." (Lancaster, 1971 p64)

4.5   Circles of Substitution

Lancaster argues that small changes in the price affect only very similar goods (those which are very close in "proportions" of characteristics), larger price changes affect a wider range of goods, and only very large price changes affect all goods.)[12]

"Thus we can describe the effect on other goods of a price fall in one good as consisting of ever-widening <u>circles of substitution</u>. . . "This is an effect quite different from that of the traditional analysis, which presumes that substitution effects are spread among all other goods in a continuous manner." (Lancaster, 1971 p66) "We can, therefore, determine the 'closeness' of substitutes from the consumption technology and consider closeness of substitution an intrinsic effect, depending on objective characteristics of goods rather than on the nature of consumer preferences. . . . Given the consumption technology, these goods can be determined a priori. Although closeness of substitution can be regarded as independent of preferences, we may have to take account of prices in any operational context." (Lancaster, 1971 p67)

This result is closely dependent on his concepts of efficiency substitution, personal substitution and the representative efficiency function, which, in turn, are very sensitive to the assumptions.

4.6 Pure Income Effects

Under the assumptions made above "If an individual consumer's income increases, with prices held constant, his feasible set in C-space undergoes a scalar expansion with no change in shape." (Lancaster, 1971 p67)

"In the traditional analysis it is usual to describe the effect of pure income changes on goods in terms of income elasticities - the ratio of the proportionate change in the quantity of a good to the proportionate change in income, prices being constant. For general purposes broad descriptive terms such as 'luxury good' (income elasticity greater than unity), 'essential good' (income elasticity less than unity but non-negative), 'inferior good' (income elasticity negative) are widely used. We can give analogous terms to characteristics (and indeed compute income elasticities of characteristics) so that we may have 'luxury' and 'essential' characteristics. . . . Can we have 'inferior' characteristics analogous to inferior goods? Not within the context of the simple linear model. An inferior characteristic would have to be one

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[12]   Again, the discussion appears to be about goods consumed separately, rather than mixing goods to produce a stew.

that was positively desired up to some income level then negatively desired." However, "A good may be inferior even though all the characteristics it possesses are positively desired" (Lancaster, 1971 p68)

4.7 The Income Effects of a Price Change
". . . just as in the Slutsky-Hicks analysis in the traditional case, we can separate the effect of a price change into income and personal substitution effects." (Lancaster, 1971 pp70-71)

5.   THE DISTRIBUTION OF PREFERENCES

5.1 A Simple Model of Preference Distribution.
Lancaster is clear that it is not possible to describe aggregate behaviour in terms of a single representative consumer. Any analysis of aggregate demand must work on the distribution of preferences over the whole population. He accepts that

> "It is clearly a task of hopeless magnitude to attempt to describe the possible distributions of preferences in any general sense. Any single individual's preferences are constrained, on standard assumptions, only by convexity and monotonicity, and the preference maps of different individuals may differ in any way, provided only that the basic properties hold for each individual." (Lancaster, 1971 p72)

Assumption 5.1: He sets up a model of preference distribution with the following properties:
"   (1) The preferences of any individual should satisfy traditional assumptions as to monotonicity and convexity of preferences.
(2) Preferences should be expressible in simple functional form.
(3) The functional form should be the same for all individuals, variations being characterized by variations in coefficients or parameters of the functions." (Lancaster, 1971 p72)

Assumption 5.2: He chooses a model based on Cobb-Douglas preference functions. His decision is evidently based on mathematical convenience rather than reality, for he accepts that "the Cobb-Douglas form is inappropriate for traditional representative consumer analysis" (Lancaster, 1971 p73), because "(a) It is homogeneous, giving unit income elasticities for both goods. (b) It has unit elasticity of substitution, so that the proportion of total income spent on each good depends only on the parameter [alpha] and is unchanged with changes in relative prices or incomes." He decides to ignore these limitations on the grounds that "As a preference function for an individual consumer in a spectrum of preferences, these specialized properties are of less concern since the properties of aggregate demand are determined by the distribution of the preference parameter as well as the properties of the individual functions." (Lancaster, 1971 p73)

5.2 Income Distribution

"Since the Cobb-Douglas function is homogeneous, all consumers with the same [preferences] will choose equivalent points on their efficiency frontiers, that is, points which transform into each other by scalar expansion or contraction of the feasible set in proportion to income." (Lancaster, 1971 p74) "Aggregate choice will, on the other hand, be influenced by the distribution of income between consumers with different [preferences]" (Lancaster, 1971 p74)

5.5 The Rectangular Distribution Model
Assumption 5.3 "The simplest possible preference/income distribution model is one in which we assume:
(1) Uniform distribution of income so that average income is constant over [alpha: the preferences]
(2) Rectangular distribution of preferences, with constant density (which we can take to be unity)" (Lancaster, 1971 p79)

Some implications of this model, which "gives, in some sense, a 'uniform' distribution of preferences" are discussed.

LANCASTER TWO

The analysis up to this stage may be called Lancaster One. It is a rigorous analysis firmly based on status boundary and fundamental assumptions. However, it is quite clear that no real markets conform to these assumptions. Accordingly, Lancaster proceeded to "relax" the assumptions, and to provide extensions and modifications in order to make it more generally applicable. This part of his work may be called Lancaster Two. In Part 2 he intends to set out the requirements for making the characteristics approach operationally useful, asking:

-        "whether we can analyze groups of goods in relative isolation from other groups"

-        "just what constitutes an operational characteristic"

-        "criteria for determining whether or not a given characteristic can or cannot be omitted in analysing a particular group". (Lancaster, 1971 p11-12)

6. EXTENSIONS AND MODIFICATIONS

6.1 Negative Characteristics
One of the basic assumptions of Lancaster One is that all characteristics are positively valued (Assumption 2.5).

The case where everyone would prefer less of a product to more is easily handled by using the negative of the characteristic, its absence rather than its presence. However

> "If a characteristic is such that some react to it negatively, some positively, or such that a particular individual reacts positively at certain income levels and negatively at others (as in the case of the satiation effects discussed in Chapter 9), we are presented with a major problem because the efficiency criteria are no longer universal." (Lancaster 1971 p97). "Efficiency choices, and efficiency substitution, still exist, but they differ between the two groups of consumers, eliminating the universality of some efficiency effects" (Lancaster 1971 p97). This problem is raised but not resolved.

The possibility that an individual may value more sweetness in wine, say, up to a certain level and dislike it after that level is not mentioned, only satiation arising from increased income.

6.2 Characteristic as Inputs
Lancaster states that the change of sign to deal with negative inputs "the absence of" is equivalent to a "process" with the characteristic as input, the change of sign as process and the new characteristic as output.

6.3 Labour, Leisure and Occupational Choices
This section is an aside does not advance the main argument.

6.4 Short-term Intertemporal Effects
"The range of this book has been set to exclude major problems of inter-temporal choice . . . Intertemporal preference analysis requires stronger assumptions, which do not have the same breadth of acceptance as the static assumptions" (Lancaster 1971 p104). He does, however, provide a brief sketch of how this might be developed.

6.5 Non-Linearity and Non-Additivity
Lancaster accepts that the basic assumptions of linearity and additivity (assumptions 2.2, 2.3) are wrong "in some cases". He states that dispensing with the assumption of additivity presents no particular problems: "If two goods, consumed together in particular proportions, give rise to a vector of characteristics which is not the sum of the vectors of characteristics of the separate goods, then we simply regard the goods combination as an activity which uses goods as inputs and produces characteristics as outputs. We then proceed as in Section 3.9 of Chapter 3" (Lancaster 1971 p107).

He suggests that the other fundamental assumption, of linearity, holds in most cases. He emphasises that his analysis relies on his assumptions that "the characteristics are technically and universally related to the goods" and states that "many cases of apparent non-linearity are due to inappropriate choice of characteristics - to

regarding a psychological effect instead of the objective property that gives rise to it, as the characteristic" (Lancaster 1971 p107). He suggests, for instance, that the relevant characteristic is not whether a good is made of plastic or metal, but the results of its being made of one or another, its durability for instance.[13] This, he admits, requires "some subtlety of interpretation of characteristics".

He accepts that there is a class of discrete or integer characteristics, which a product either has or has not. Redness or blueness are examples he gives. He examines some possibilities briefly but even with

> Assumption 6.1 that price is independent

he finds it difficult to find any general conclusion. He accepts that each integer characteristic has a separate axis, and that his model is uninformative on choices where one good is blue and another red. This example also breaches his basic assumption that all goods share all the same characteristics.

This section, therefore, states that "most" apparent non-linearities can be resolved by "subtle" definition of the characteristics. It recognizes that there are integer characteristics which are not well handled by the model, but does not recognize that those cannot exist under his basic assumptions. No other forms of non-linearity are mentioned.

7. MAKING THE THEORY OPERATIONAL

7.1 Bridging the Gap
The following chapters are intended to bridge the gap between the model presented previously and an operational model.

7.2 Operational Definition of a Characteristic
He re-emphasizes his point that each characteristic used in his approach must be an objective, universal property of the good, or activity. Obviously this rules out the approach for some purposes ". . . we shall not pretend that our model will be operationally useful when aesthetic considerations are dominant" (Lancaster 1971 p114)

8 GROUP ANALYSIS

8.1 Reducing the Universe

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[13] This implies that durability is an objective characteristic, and does not depend on differences between users in the use to which it is put, or to differences in the skill with which it is used, the care and maintenance, etc.

The basic model covers all goods, so that it does not matter whether a consumer gets his or her acetic acid from vinegar, chips or wine. If the model is to be made operational, the first requirement "is to find the circumstances (assuming they exist) under which we can analyse part of the total consumption universe in relative isolation from the remainder. We seek conditions under which the analysis of goods can be carried out in groups, one group at a time." (Lancaster 1971 p116).

This problem is of crucial importance to Lancaster's theory, because it is based on the assumption that a given characteristic can come from any of a number of different goods and gives the same satisfaction whichever good it comes from. Other traditions start with a quiddity, that an apple is not a brussels sprout or an orange, and work largely within that quiddity (e.g. Waugh, 1928).

8.2 Intrinsic Groups

Assumption 8.1
An extreme case is one where groups of goods are completely separable. For example there might be a case where "(i) no good in the goods subset possessed any characteristic not in the characteristic subset; (ii) no characteristic in the characteristics subset was possessed by any good not in the goods subset". (Lancaster 1971 p126)

In this extreme formulation there can be efficiency substitution effects within the group, with the consumer changing to a more efficient mixture of characteristics after a price change. There cannot be an efficiency substitution between this group and other products, only the normal substitution between two quite different products. It is possibly, but not always, the case that substitution within groups will be greater than substitution between groups, but he assumes the following:

Assumption 8.2
"We shall generally assume in our analysis that private substitution effects are greater within a group than across groups, and given the additional efficiency substitution effects, that the overall substitution effects are noticeably higher within groups than across groups." (Lancaster 1971 p127)

Assumption 8.3
"The prices of other relevant parameters for goods outside the group remain constant". (Lancaster 1971 p128)

Assumption 8.4:
"The group can be analysed in isolation . . . as though the set of characteristics associated with it are the only relevant characteristics for the time being". (Lancaster 1971 p128).

Assumption 8.5:

All other goods are may be treated as identical, all being equally close or distant substitutes for this group. (Lancaster 1971 pp128-9).

The assumptions in Lancaster One mean that the feasible set, the amount that can be brought with a given budget, changes in scale but not in shape as the budget changes. In this case, changes in the price of the non-group changes the budget available for the group, so there is a scalar change only. The Lancaster One analysis can be applied within the group.

Assumption 8.6:
It is implicitly assumed that changes in the price of group and non group products are independent of each other.
He concludes "A sufficient condition for the feasible set in C-space (group characteristics space) to be subject only to pure scale changes as a result of events outside the group is that the group be intrinsic and defined by a completely separable consumption technology." (Lancaster, 1971, p.130).

He does not discuss whether these pure scale changes are the same for everybody, or how they affect aggregation.

"The conditions to be satisfied for preferences [to be unaffected by events outside the group] are rather more complex. For the 'shape' of the indifference contours in C-space to be unaffected by the quantity of goods outside the group (hence characteristics outside the group), it is necessary that the direction of the normal to the tangent plane at any point on the contour be unaffected by the quantities outside the group. . . This condition is satisfied by the Cobb Douglas type of function." (Lancaster 1971 pp 130-1).

He does not argue that this extreme formulation of a separable group will mean that the indifference curves are not affected by events outside the group. He states that if there is a separable group, and if the indifference curves are not affected by events outside the group then,

> "the preference (utility) function can be expressed as the product of two functions, one of characteristics in the group only, the other of characteristics outside the group only. . . The Cobb-Douglas form is simply a special case of a multiplicatively separable function." (Lancaster 1971 p132)

He does not argue that the Cobb-Douglas form is necessary, or likely. In a non-sequitur he asserts:

> "The simple model of demand behaviour, based on a linear technology and distributed Cobb Douglas preferences, can be applied

without modification to demand within a group, provided the group
is defined by a completely separable technology matrix" (Lancaster
1971 p132).

What does it imply when he says that the shape of the indifference contours are not
affected by the quantity of goods outside the group? It suggests for instance that a
change in the price or availability of petrol does not affect a consumer's preference
for big cars rather than small ones.

Assumption 8.7:
There are a great many implicit assumptions on characteristics and consumption
technology here.   On his definition consumption technology is the technical
relationship between a basket of goods and the characteristics they contain. It has
nothing to do with how people consume or how they evaluate what they consume,
and it is something that a basket of goods has, not that a consumer has. The fact that
one group of goods has a given consumption technology does not imply that there
are not other goods with an entirely different consumption technology that can give
virtually identical satisfactions. Hamburgers and vegebergers, meat and textured
vegetable protein may be close substitutes though not sharing characteristics (of
course if amino acids, nitrogen atoms etc. are taken as characteristics, they do share
the same characteristics - but then the concept of a separable group is absurd).
Similarly orange juice and Diet Coke may have no ingredients in common but be
close substitutes; so may potato crisps and sweets.

Accordingly, Lancaster is not stating that it is valid to use the Lancaster One model
on an a group of goods, ignoring all other goods providing they are completely
separable, with no overlap of characteristics. He is suggesting that if further
restrictive assumptions, implicit and explicit, are added, a situation might
conceivably exist where this was valid.

8.4 Universal Characteristics
Since he accepts that the assumption of complete separability is unlikely to be met,
Lancaster constructs a scenario of one situation where some, but not all, of the
separability conditions are not met.

Assumption 8.8:
"The group consists of a subset of goods which possess characteristics which can be
divided into two subsets: (1) a subset of characteristics possessed by no goods
outside the group ['group characteristics']; (2) a subset of characteristics which are
also processed [sic] by all, or a large number of, other goods in the universe.
['universal characteristics']" (Lancaster 1971 p132)

Assumption 8.9:
There is a single universal characteristic. He attempts to determine the feasible set

of characteristics within the group for different values of the universal characteristic. He argues that, to give valid results (not defined) several assumptions have to hold

Assumption 8.10:
"(1) The cost of obtaining a unit of universal characteristic should be less through purchase of the good possessing only that characteristic than through the purchase of a group good" (Lancaster 1981 p135) "since the universal characteristic is its only characteristic while [the group good] provides other goods as well." (Lancaster 1971 p134). For this to be so, Assumption 2.5, of all characteristics being positively desired at all levels, must hold.

Assumption 8.11:
There is also an implicit assumption that there is only one group. If non-group goods are all other groups, also containing the universal characteristic, again this need not hold. He did in fact start talking of a situation with several groups (Lancaster 1971 p133).

Assumption 8.12:
The required quantity of universal characteristic could be obtained by expenditure on goods entirely outside the group.

Assumption 8.13:
"The required quantity of universal characteristic could not be (or could only just be) obtained by expenditure entirely within the group." (Lancaster 1971 p135-6).

The first condition means that consumers will prefer to buy the universal characteristic by buying the universal good and only buy it through other goods to get the other characteristics. With the other conditions it means that the price of the universal good is always significant in the decision.

For a given amount of the universal product purchased, a sum is spent. If this is subtracted from the budget, what remains is a budget for the group.

The prices used in the group are adjusted to allow for the fact that some of the universal characteristic is bought.

Assumption 8.14:
The ratio between market prices and adjusted prices is the same for all goods in the group (Lancaster 1971 p137).

Under this assumption the shape of the feasible sets remains unchanged. However he accepts that this assumption can only hold at one vector of relative prices for group goods.

> "What they amount to is that if, for example, all automobiles posses a universal characteristic in addition to characteristics specific to automobiles, the amount of this characteristic, per dollar of automobile, is approximately the same from one automobile to another" (Lancaster 19871 p137). While he says this is realistic, he does not say why a Maserati should have 25 times the universal characteristic of a Skoda.

Assumption 8.15:
The cost of obtaining each of the universal characteristics is the same for all goods in the group. (Lancaster 1971 p138).

Assumption 8.16:
Every good in the group possesses the various universal characteristics in the same proportions.
These assumptions are a mixture of assumptions about individual preferences and market supply and demand.

The analysis shows that with a large number of assumptions, a scenario may be imagined in which the Lancaster One model could be applied to groups, with an approximately equal distortion in prices for all goods in a group.

9 RELEVANT CHARACTERISTICS: A PRIORI CRITERIA

9.1 The Notion of a Relevant Characteristic
The model can only be operational in Lancaster's view, if it can be confined to a relatively small number of characteristics, preferably fewer characteristics than the number of goods, otherwise it has no great superiority over the traditional model where each quality of good is treated as a separate good.

Assumption 9.1:
The analysis ignores characteristics that are not "relevant", and must do so to be meaningful, as it would not be feasible to include all the characteristics of each product in an analysis. A characteristic is defined as relevant "if ignoring its existence would lead to different predictions about the choice or ordering of the goods by consumers" Lancaster (1971 p140). Relevant also means relevant to the group of goods. (Lancaster 1971 p14). Lancaster explicitly states that relevance in his sense relates to the system of analysis that he uses, which suggests that he may recognize that it does not apply with alternative theories, or indeed with individual consumers' choices.

He argues that characteristics could be deemed irrelevant either because of the relationship of humans to that characteristic (they may ignore it for instance) or because of the misleadingly named "consumption technology" the relationship

64

between a bundle of goods and the bundle of characteristics it produces.

9.2 Technical Irrelevance

Several assumptions are made by analogy with the conclusions for the special cases developed in chapter 8.

Assumption 9.2:

"Universal characteristics are irrelevant to the small group". (Lancaster 1971 p141). This is an extreme assumption so he says it may be necessary to draw on the less extreme version of Assumption 9.3.

Assumption 9.3:

"A universal characteristic is irrelevant to the group if the contents of this characteristic, per dollar spent, is approximately uniform over goods in the group." (Lancaster 1971 p141) (This is intended to hold only if relative prices of group goods remain within a certain range).

Assumption 9.4:

"A characteristic which is invariant over the group is irrelevant. By "invariant" here we mean either a characteristic of the (0,1) kind which is simply present or absent or a qualitative characteristic which, owing to some kind of technical saturation, can be possessed only up to some maximum amount." (Lancaster 1971 p 142). He accepts that invariance and linearity, his boundary assumptions, are inconsistent with this.

Assumption 9.5:

It is assumed that the technology is linear, after ignoring invariant characteristics and that a characteristic is irrelevant if there is linear dependence in the technology. The example he gives is one where the linear dependence of one row of a technology matrix is the same as, or a scalar multiple of, some other row (Lancaster, 1971 p142).

Assumption 9.6:

"In many cases of course it will be appropriate to assume that characteristics technically related in this way [as in Assumption 9.5] are also related in the view of the consumer so that he reacts to any one of the related characteristics, not to each of them separately" (Lancaster 1971, p144).

Assumption 9.7:

"If two or more characteristics are possessed by all goods in fixed ratio to each other, we can treat all but one of them as irrelevant. However, if prior information concerning complete preference is available, the preference function must be suitably transformed in some cases" (Lancaster 1971 p144). Characteristics rejected on this criteria are called "technically redundant".

". . . we have shown that characteristics can usually be ruled out as irrelevant for

group analysis if they are: (i) universal characteristics; (ii) invariant over the group; (iii) technically redundant over the group". (Lancaster 1971, p145).

Here very different situations have been linked as having the same result.

9.3 Human Irrelevance
Assumption 9.8:
"A characteristic is totally irrelevant if it does not appear in consumers' preference functions ('satisfies no wants') either positively or negatively. Since we are concerned with aggregate market behaviour in typical applications of the model it is sufficient for total irrelevance that the characteristic does not appear in the preferences of a large proportion of the consumer population. We can often also rule out a characteristic that has a very low weight in preferences. . . " (Lancaster 1971, p146).

9.4 Satiation Effects
Lancaster assumes that each characteristic satisfies a want. Satiation implies that a consumer has no further positive interest in further quantities of the characteristic, that is to say, he has either a zero or a negative interest in further quantities. He calls the situation where there is zero interest open satiation and the case where there is a negative interest close satiation. There may be a neutral zone of open satiation before the level of closed satiation is reached. The example he gives is calories in a diet, and the analysis is almost identical to the one where goods are used rather than characteristics.

He concludes that "At high income levels, some characteristics may become irrelevant because of open satiation effects. At lower income levels, these characteristics may be relevant" (Lancaster 1971 p152) and "Closed satiation does not necessarily provide any criterion for irrelevance. It may complicate the analysis a great deal by causing switches in preferences on a characteristic from positive to negative" (Lancaster 1971 p159).

9.5 Dominance and Hierarchy
There may be a dominance in preference. For example, with nutrition.

"(1)   At very low calories, calories are dominant.
 (2)   At medium calorie levels, flavour is relevant.
 (3)   There is a neutral zone with respect to calories - open satiation at one
              level, followed by closed satiation at a higher level.
 (4)   Flavour is non-satiable." (Lancaster 1971 pp154-5)

He concludes that the operationally relevant characteristics may depend on levels of real income, because of satiation and hierarchy effects.

10 REVEALED RELEVANCE, WITH AN APPLICATION TO THE UNITED STATES AUTOMOBILE MARKET

10.1 The Problem

"The aim of revealed relevance techniques is to use observed market data to deduce something about whether certain characteristics are or are not relevant in the characteristics sense - that is, whether consumers appear to react to these characteristics or not" (Lancaster 1971 p157). (This definition of relevance is at variance to the one he used in the previous chapter).

Assumption 10.1:
Lancaster restates the fundamental assumption he has made in earlier chapters as being critical in this context.

"No consumer will choose an inefficient goods collection, that is, one which possesses less of some characteristic or no more of others than some other available collection. Thus a good which is actually sold cannot be part of an inefficient collection in the above sense. If it appears to be so, it is because we are not taking into account the proper set of relevant characteristics". (Lancaster 1971 pp157-8).

He proceeds to examine what happens when someone using his analysis (Lancaster Two)

a)   ignores a characteristic that is relevant or
b)   includes a characteristic that is not relevant

10.2 Ignoring Relevant Characteristics

Ignoring relevant characteristics can lead to incorrect predictions about what people will buy. Some predictions are about aggregate market behaviour, and can be falsified by aggregate market data. Other predictions e.g. that no individual would consume three different goods simultaneously, cannot be falsified by aggregate data (except in extreme cases).

Under these assumptions it can be concluded that a relevant characteristic has been ignored if

a)   A good is sold in spite of being inefficient in terms of the **s** goods used in the analysis (market data).
b)   <u>Individuals</u> consume more than **s** goods (data on individual market behaviour).

It is possible that it will also be the case when a good dominates the market, but cannot be shown to be dominant in terms of the characteristics used.

10.3 Inserting Irrelevant Characteristics

In an earlier section Lancaster said that a characteristic was relevant if "ignoring its existence would lead to different predictions about the choice or ordering of the goods by consumers" (1971 p140) and he analyses characteristics accordingly. In this section he examines what happens if his model includes a characteristic that is irrelevant to consumers. Here he appears to be talking of characteristics that do not influence consumers' choices but that do lead to different predictions in his model. Under the first definition it does not matter whether or not a characteristic that does not affect consumer choices is included, as long as the consumer preference function is known.

If a characteristic is assumed to determine consumer choice when it does not

a)   Some efficient choices may seem inefficient because they have none of that characteristic.
b)   Some inefficient choices may seem relevant because they have a lot of that characteristic.

The question arises: if a model has been constructed using characteristics that do not in fact affect consumer choice, can the economist find this out? Lancaster produces weak criteria, "presumptive conditions for the existence of irrelevant characteristics".

-                     that if there are **s** characteristics, no individual consumes as many as **s** different goods (individual market data).

-                     that some good, predicted as efficient, is not actually sold (aggregate market data).

-                     dominance exists, though not predicted (though this can also exist when relevant characteristics are excluded).

LANCASTER THREE

This brief section has been classified as Lancaster Three, as it does not share the same assumptions as Lancaster One, Two, or Four.

10.4 REVEALED RELEVANCE IN THE UNITED STATES AUTOMOBILE MARKET

The final section of the book aims to show that a small number of characteristics can "explain" the fact that a large number of goods are bought. By assumption,

consumers will not buy anything unless it is on an efficiency frontier. They will buy another good if it offers more of at least one characteristic and no less of any other characteristic. Lancaster aims to show that a small number of characteristics is enough to put a large number of goods on the efficiency frontier.

He uses the example of the United States automobile market, surprisingly, as it does not conform to any of the assumptions in Lancaster One.

Assumption 10.2:
He assumes that someone buys one automobile and one automobile only and must get the optimal mix of characteristics from that purchase only, not by combining characteristics from different automobiles or from other groups of goods. This means that the efficiency frontier is represented by a series of points, not by the lines joining points, as in the rest of his book.

Assumption 10.3:
It is assumed that consumers will only buy goods if they are on the efficiency frontier.

Assumption 10.4:
The budget constraint is dealt with by treating price as a characteristic just like any other.

Assumption 10.5:
It is assumed that each model, a Nova or a Biscayne, has one unique specification. The characteristics used are Consumers' Union rankings on size and comfort of seating etc., ride qualities, handling and steering, engine quietness and performance, brakes, frequency of repair record and manufacturer's suggested price. (None of these are characteristics within the definitions made in Lancaster One and used up to this stage).

He then shows that five of these characteristics are enough to put all the 22 models he considers on efficiency frontiers. He concludes that "the automobile market is readily amenable to rational analysis in terms of straightforward characteristics of cars, without using such imponderables as 'styles' or any sex at all." (Lancaster, 1971, p.174).

In fact he has not shown that the characteristics mentioned are relevant, or that no other characteristics are. Nor has he shown that consumers choose on a small number of characteristics. He has argued only that it is possible to select a few characteristics of the many possible characteristics which would put all options on an efficiency frontier.

LANCASTER FOUR

In this section the basic concepts of Lancaster Four are set out. These are the concepts to be found in the opening chapters of <u>Variety, Equity and Efficiency</u> (1979). Some of the concepts were first expressed in Lancaster (1975), but he now accepts that this had fundamental flaws in it, flaws which he tried to correct in 1979, so this discussion will be confined to the presentation in <u>Variety, Equity and Efficiency.</u>

INTRODUCTION

1.1 The Problem

Lancaster (1979) examines issues of variety, of equity between consumers and of efficiency in providing the good. An optimal system in his analysis is one where, after the winners have compensated the losers, no one is worse off under this system than under others, and the cost is lower. <u>A second best optimum</u> is one where there is no compensation, but where on average the population is better off (p2). There is a problem of <u>manifest equity</u> when individual preferences of one kind over another are not directly related to objective external parameters - some people are quite happy to be offered only grey cars.

The problems of a tradeoff between variety, equity and efficiency arise:

1   -   when there is variety in individual preferences.
2   -   when there is potential variety in the product.
3   -   when there are economics of scale in production (including economics of scale in distribution and inventory).

1.2 Variety in Tastes

<u>Assumption 1.1:</u>
It is assumed that individual variations in tastes or preferences are real and substantial. The possibility of tastes being manipulated by advertising is assumed away, or at the least it is assumed that, once formed, tastes are relatively stable. The "true" preferences are those that are, or would be, revealed by actual choice, not some "what they really want". The analysis is confined to product variety within a group, not with the introduction or totally new product groups, like calculators.

<u>Assumption 1.2:</u>
It is assumed that an individual's welfare depends only on his or her own consumption, and there are no consumption externalities, such as pleasure one gets from seeing that other people get the quality they want (Lancaster 1979, pp11-12).

Assumption 1.3:
It is assumed that there are economies of scale in the production of large quantities of a product to any single specification. (Lancaster, 1979 p12)

Assumption 1.4:
It is assumed that the economies of scale are specific to a particular product variant and there are no joint economies of scale between different products of the same group. (Lancaster 1989 p12)

Assumption 1.5:
It is assumed that all such economies are made use of, and that everything is produced with the least possible resources. (Lancaster 1979 p12)

Assumption 1.6:
It is assumed that goods can be produced to any specification within some feasible product range. (Lancaster, 1979 p12)

"All these assumptions are reasonable in a general analysis of product variety which is designed to establish broad patterns, not to produce specific solutions for individual cases". (Lancaster, 1979 p13).

1.4 The Scope of the Study
"This is a theoretical study of the optimal degree of product variety in an economy in which the technology exhibits economies of scale and the population has varied tastes . . . " (Lancaster, 1979 p13).

Assumption 1.7
"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 PDC at the specification corresponding to the most-preferred good." (Lancaster 1979 p47)

2 A FRAMEWORK FOR ANALYSIS

2.2 The Characteristics Approach
The fundamental approach on which the analysis Lancaster Four and Five depends is the one developed in Lancaster (1966, 1971). It has similar assumptions.

Assumption 2.1:
Individuals are interested in goods not for their own sake but because of the characteristics they possess. (Lancaster 1979 p17)

Assumption 2.2:
It is assumed that there is full information (Lancaster 1979 p17).

Assumption 2.3:
The characteristics which appear in the analysis are assumed to be objectively quantifiable as well as objectively identifiable. (Lancaster 1979 p18).

Assumption 2.4:
It is assumed that preferences over characteristics are stable but that preferences over goods may change if the characteristics composition of the goods changes. (Lancaster, 1979 p18)

Assumption 2.5:
It is assumed that "if a diagram is drawn with different characteristics along the axes . . . the indifference curves will have the properties of being convex toward the origin, of being nonintersecting, of representing more preferred collections when further from the origin . . . Similarly, the utility function will have the form U(z) where z is a vector of characteristics rather than of goods, but will possess the usually assumed properties." (Lancaster 1979 pp18-19).

2.3 Goods as a Transfer Medium
Goods are simply a transfer medium by which characteristics are bundled up into packages at manufacturing and are opened out at consumption. "The technology of consumption determines whether consumption of the good is combinable with that of other goods (breakfast cereals with sugar and milk for example) to give a combination having characteristics derived from all components or whether it is noncombinable and the collection of characteristics contained in the good must be consumed as fixed bundle." (Lancaster, 1979 p21). (This is not the "consumption technology" of Lancaster One, where it is the mix of characteristics obtained from a basket of goods, and where the question of combinability does not arise).

2.4 The Consumption Technology
In Lancaster One linearity and additivity of characteristics is assumed.

Assumption 2.6:
It will be assumed here that there is linearity whenever goods are divisible and can be assumed in any quantity, but not "when goods are indivisible (like automobiles and most consumer durables) and must be used in a fixed package size." (Lancaster 1979 p22)

Assumption 2.7:
The assumption of additivity, that the characteristics of two or more goods could be determined by adding up the quantities of each characteristic contained in the specified quantities of each good is discarded for most of the analysis. Instead the

distinction is made between <u>combinable</u> goods and <u>non combinable</u> goods. (Lancaster 1979 p22-3)

"It is the author's view that, although the original characteristics analysis was based on the combinable and additive model and a considerable literature has grown up around this model, the true power of the characteristics approach is most evident in the analysis of goods, the consumer durables, in which non combinability is the rule". (Lancaster 1979 p23) "Non combinability is strongly associated with high technology, manufactured goods, combinability with agricultural products or low technology manufactures . . . " (Lancaster 1977 p24). He appears to be saying that even if these assumptions are made, the Lancaster One or Two model might apply to most agricultural inputs and outputs, but not to inputs like tractors.

The assumptions of divisibility and additivity are fundamental to Lancaster One and Two and it was stated that Lancaster One and Two are fundamental to Lancaster (1979). It is not clear how part of the model could be based on this, while another part of the model no longer assumes divisibility and additivity. The dropping of the linearity assumption here could be interpreted as applying only to goods like automobiles where a consumer buys one item only. For all other goods linearity is still assumed. The introduction of the possibility that characteristics from different goods cannot be combined is more fundamental, but the implications are not argued.

2.5 The Group
In Lancaster Two there was a struggle to formalize the notion of a group of goods and a fragile model was built of highly restrictive special cases based on a lot of <u>ad hoc</u> assumptions (e.g, Assumptions 8.1 to 8.16). Here he states: "The idea of a group can easily be formalized in terms of characteristics . . . " (Lancaster 1979 p24) and he goes on to repeat the special conclusions of Lancaster Two as though they had general applicability.

<u>Assumption 2.8:</u>
All goods in a group are produced by similar technologies. Each producer of any product in the group is capable of producing any good within that group.

2.6 Product Differentiation
<u>Vertical product differentiation</u> is taken to exist where the absolute quantities of all characteristics per unit of the good are increased or decreased. "Vertical quality change is of interest only in the use of indivisible goods" (Lancaster 1979, p28). "This book is concerned with the analysis of <u>horizontal</u>, rather than vertical product differentiation". Product differentiation is seen as essentially horizontal when goods are divisible. "With indivisible goods, which are also introduced into the analysis . . . Two goods, one of which has 20 percent more of every characteristic per unit quantity than the other are obviously vertically differentiated. When one good has 20 percent more of some characteristics and no more of others, there is obviously a

mixture of vertical differentiation and horizontal differentiation (the latter occurs because the characteristics ratios between the goods differ)" (Lancaster, 1979, p.28).

The concept of a good having more of a characteristic <u>per unit</u> is a new introduction.

2.7 Differentiation Possibilities

<u>Assumption 2.9:</u>
It is assumed that product differentiation is potentially continuous over the group, within some limits set by the potential differentiation range.

<u>Assumption 2.10:</u> It is implicitly assumed that it costs more to produce a product with more of the characteristic.

CONCLUSION

The purpose of this chapter has been purely to summarize Lancaster's theory as he presents it, emphasizing the assumptions made. It has not been an objective to set out the framework or points of concern: this was done in the previous chapter. Nor has it been an objective to test the theory.

LITERATURE REVIEW

In the first part of this chapter alternative approaches to the economics of quality are discussed. The aim is twofold. First, it is shown that there are many different approaches in existence, so there is no virtue in developing a new theory to replace Lancaster's. On the contrary, anything that can be done to reduce the number of apparently acceptable approaches to a manageable number is a valuable service to the profession. Secondly, it will be shown that most of the approaches share at least some of Lancaster's assumptions and analysis. This means that the points raised in this refutation are not just criticisms of one approach, even if it is the dominant approach, but criticisms that have a wider relevance. The implication is that most of the approaches will require adjustments to allow for the insights introduced here, and the theories most like Lancaster's will have much the same limitations.

In the second half of the chapter the literature relating to Lancaster's theory is discussed, both to show his dominant position in the paradigm and to show what criticisms have been made in the past.

The literature on the economics of quality is enormous so this review is selective and inevitably leaves out much that would be relevant to discussions of other aspects of the economies of quality. A bibliographic study of recent publications citing Lancaster was carried out for this refutation, in order that the literature on Lancaster could be thoroughly and systematically examined. While this proved possible for the literature on Lancaster, it proved that a similar coverage of the rest of the literature on the economics of quality would not be possible: the study showed that those people citing Lancaster cited some 6000 other publications. Since people working in other traditions may not have cited Lancaster at all, there could well be 10,000 to 20,000 or 30,000 publications on different aspects of the economics of quality. Inevitably it has been possible to cite only a tiny fraction of these. Inevitably, too, the selection is personal, as the papers that seem salient depend very much on the papers an individual happens to have seen and the order in which they were seen. The choice of literature was also determined by the objective of this refutation, and there is not a major overlap with the literature cited by the author when addressing other aspects of quality (e.g. Bowbrick, 1981, 1982, 1992).

HEDONIC MODELS

The oldest of the modern approaches to product quality, and still one of the most used, is the hedonic approach where the prices of goods at market level and their component characteristics are observed, and a regression is run to show the relationship between prices and characteristics. On the basis of this, predictions are made of the price of a product with a certain characteristics mix, or the market share of a product with a certain price and characteristics mix. This differs from the Lancaster model in that it is modelled entirely at market level, with no analysis of individual decisions; that market responses are of key importance; that both characteristics and attributes are used; that assumptions on linearity and additivity are not made; that it is not concerned with the complete consumption decision; and that it is firmly rooted in the real world.

Waugh's (1928, 1929) study of quality and prices of vegetables in the Boston wholesale market was the first of a long line of studies using the hedonic approach. The study took the form of recording prices and quality characteristics of vegetables in the wholesale market and running regressions. On the basis of this it was possible to predict the price of a marginal unit of a product with given characteristics. The design of this study permitted a rigour which many subsequent studies have not been able to achieve. In such a market, for instance, it is not unreasonable to assume perfect competition, or that supply is perfectly inelastic within a single day. This means that each day's prices could be seen as equilibrium prices at different levels of supply. He was able to analyse the impact of characteristics on price at different supply levels and on different days of the week.

He concludes that:

> "There is a distinct tendency for market prices of many commodities
> to vary with physical characteristics which the consumer identifies
> with quality, and the relation of these characteristics to prices may in
> many cases be fairly accurately determined by statistical analysis".
> (1929, p.87).

This is therefore a "characteristics approach". It should be noted though that not many of the characteristics used would be permissable in Lancaster's theory. For example condition, growth cracks, uniformity, ripeness and taste but are certainly not linear or additive and some are not objectively measurable. Waugh considers uniformity important, and most people trading in such markets consider it a very important determinant of price. It is surprising, therefore that it makes little appearance in the literature apart from Bowbrick (1982, 1992). It is not a straightforward concept and it does not fit into Lancaster's model, for instance.

OTHER STUDIES

The hedonic technique, using multiple regression to relate price to level of characteristics has been used on many products over the years. John Raeburn (1939) used it on apples, Court (1939) used it on motor cars and was followed by Dhrymes (1967), Triplett (1969), Griliches (1971), Cowling and Cubbin (1971),[14] Agarwal and Ratchford (1980) on motor cars, Rayner on farm tractors, Rayner and Lingard (1971) on fertilizers, Goldman and Grossman (1978) on paediatric care, and Perrigaux et al (1938), Hyslop (1970) Morgan, Metzen and Johnson (1978) Neville et al (1976) and many others on agricultural products. The approach is widely used in land economics (e.g. Flemming and Nellis (1985, 1992), who include locational factors)

ADVANTAGES AND DISADVANTAGES

The major advantage of the hedonic approach is that it works directly with easily observable market prices and characteristics.

It does not require observations of individual buyers, nor does it require a process of aggregation from the individual buyer to market demand.

It does recognize the importance of the market, which is given little weight in Lancaster. However, because of this, its predictions are at the margin. Waugh was able to argue that because long asparagus got a given premium in the past, the marginal producer would get the same premium if he switched to producing longer asparagus. If any large number of people changed their production, the premium would fall. While such market effects can be expected in nearly all markets, they are not given prominence in many approaches to quality.

There is a major conceptual problem: what exactly does a market price mean? Waugh's model is of a series of discrete, market clearing, instantaneous markets, each having a perfectly inelastic supply within the market period, and a demand which, if not constant, was the same each Monday, each Tuesday and so on. No assumptions on costs or supply functions are needed. Producers are price takers. Raeburn's (1939) model was of apples sold in a similar market, but because the apples are not as perishable, the same assumptions did not hold. Producers could store the apples if the price one day was not high enough, and any buyers with apples in stock could postpone purchases. The models of motor car quality make a bigger switch still. They refer to a situation where the producers are price makers. They can determine what characteristics to give their products, and what price to charge, and their supply is perfectly elastic over the range covered by some models. The

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[14]   Cowling and Cubbin relate brand share to the residuals of a hedonic price function.

characteristics tend to be "bolt-on" features like air bags and radios, so their marginal production cost is easily determined.

> "It is possible to regard these weightings as reduced form coefficients that reflect both supply- and demand-side factors. However, one may also try to interpret them either as reflecting consumer evaluations of the relative importance of characteristics, with consumer sovereignty acting so as to force market prices to correspond to these evaluations - hence the 'foundation-providing' role for Lancaster's analysis - or as indicators of the marginal cost to the typical firm of adding a particular characteristic to its products, in situations where oligopolistic firms are pricing according to cost plus methods". (Earl 1986 p92)

Studies of the price of houses or agricultural land have the problem that only a small proportion of the stock is sold in any one year. There is an enormous hidden reservation demand: most farmers want to keep their land and most house owners want to keep their houses. Data on prices and characteristics of land actually sold does not reflect this. The same problem arises with durables like cars and tractors, though less obviously.

This suggests that the first step in any hedonic study should be analysis of market structure and market operation, to see what market prices might indicate.

The selection of characteristics to include in such a regression might be done through some of the consumer level studies used in marketing, which are discussed below, so the different approaches can be complementary. This approach can result in improved specification. The alternative approach of identifying and specifying characteristics from the data requires careful handling if it is to be valid. Mis-specification is a possibility. Two forms particularly difficult to guard against arise when one characteristic can contribute to two totally different forms of satisfaction or when two characteristics must be combined to produce a given satisfaction.

The problems in specification and the problems in determining what a price indicates in a specific market, means that the approach cannot be applied routinely to market after market without thought. If it is, the conclusions are likely to be of the order of "for reasons we do not understand, the characteristics that appear to influence price are x, y and z, and the best fit in the past has been produced by a linear relationship. It is our hypothesis that in the future this same relationship will hold".

The models generally are confined to goods within a single group. They usually refer to units of a good, to a package, or to a fixed amount. Linearity and additivity are not assumed - two sticks of short asparagus are not equal to one long one. The original work was in terms of objectively measurable characteristics (though there

was clearly subjectivity in determining which measure of uniformity to use for instance). In some approaches subjective measures may be used, using common subjectivity like a brand image instead of an objective characteristic, and in some approaches perfect information is not implied. The implications of the assumptions are not always spelt out.

While the mechanics of this approach may be applied quickly and easily in a wide range of circumstances, running a regression between price and any characteristics or attributes that may seem to be relevant, it is necessary to carry out some economic analysis of the market if the results are to be meaningful.

ECONOMIC MAN MODELS

There are several economic models starting with assumptions about the behaviour of economic man. These are based on assumptions about the choice and optimizing process of a rational purchaser. They do not aim to describe how people actually behave, or to be consistent with market research results. In most cases there is an attempt to aggregate from a single consumer's preference for quality to a market demand for characteristics or attributes. This poses enormous problems, and in many cases realism in the modelling of consumer choice has been sacrificed for a model that makes aggregation easier.

Models in this category include Lancaster and similar models, Rosen (1974), Houthakker (1952), Thiel (1952), Brems (1948, 1957), Leland (1977), Leffler (1982), Ladd and Suvannant (1976), Ladd and Zober (1978) and Ratchford (1979) and there is a vast literature based on these. It is clearly not feasible to examine all these in detail here. Instead, Rosen (1974), which is the next most cited paper after Lancaster, will be examined, then, more briefly, other approaches.

ROSEN'S MODEL

Rosen (1974) starts with much the same assumptions as Lancaster.
-        Goods are valued for their utility bearing characteristics.
-        Characteristics are objective and are perceived in the same way by all consumers though they may be valued differently.
-        Goods in a group ("products in a class" in Rosen's terminology") are defined uniquely by their characteristic mix.
-        Goods and characteristics are valued positively.
-        Indifference curves are similar to those assumed by Lancaster (though they are projected on different planes as shown in Fig. 4.1).
-        Characteristics are positively priced.

- Linearity is assumed (but not additivity).
- Both have similar confusions about the characteristics space in which they are operating, with much of Rosen's being the space when an individual is producing a single unit of a good within a group (akin to Lancaster's automobile example).

To the extent that Rosen's theory shares the assumptions of Lancaster's it is subject to the same criticisms.

Some differences are:

- Broadly speaking, Lancaster One, Two, Three and Four are concerned chiefly with a comparison of individuals' demand, with market demand being mentioned but not analysed, while Rosen's main objective is to work from assumptions about individual producers and consumers to market prices.

    Rosen takes each good as a package whose component characteristics cannot be untied.[15] He accepts the possibility of limited additivity but assumes for the model that it does not exist (Rosen, 1974, p.37).

    While Lancaster's model can have consumers buying goods as raw materials and combining them, so that consumers are producers, Rosen assumes that producers produce and consumers consume.

    Rosen uses price as a dimension of quality for a unit of a good while Lancaster's assumptions do away with price as a dimension.

    Rosen has detailed assumptions on supply prices, while Lancaster does not consider this until Lancaster Four.

The argument is that the consumer attempts to maximize his total utility subject to a budget constraint and does this when the ratios between the marginal utilities from any pair of characteristics are equal to the ratios between their marginal prices. Rosen develops a bid function, resembling an indifference curve, showing the price the consumer is willing to pay for alternative bundles of characteristics.

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[15]   "For example in terms of one characteristic, two 6-foot cars are not equivalent to one 12 feet in length since they cannot be driven simultaneously (case [i]); while a 12-foot car for half a year and a 6-foot car for the other half is not the same as 9 feet all year round (case [ii]). Similarly, assume sellers cannot repackage existing products in this manner or do not find it economical to do so .... "(Rosen, 1974 p.38). This is a clear criticism of Lancaster's boundary assumptions which ruled out such goods.

A similar supply model is constructed, with an offer curve joining combinations of characteristic that a given producer will supply for a given sum of money. Where the offer curve is tangential to the bid curve a bargain is struck.

From the offer prices of different producers and the bid price of different consumers an equilibrium price is reached for each characteristic mix.

The hedonic prices are the implicit prices of attributes and may be estimated by product price regressed on characteristics.

Rosen presented his paper as a structured interpretation of the hedonic method. It is sometimes stated that Rosen provides the theoretical basis for hedonic analysis (e.g. Steenkamp 1989, Earl 1986, Ratchford 1979). The suggestion is that Rosen shows how there can be a market equilibrium where different prices exist for products with different product mixes, and that this enables us to interpret market equilibrium prices correctly. For this to be so the models of consumer demand and producer supply would have to be correct for the product being examined. More demanding still, the market structure would have to be such that aggregation from individuals to market supply and demand was in the way postulated. It is not the purpose of this refutation to examine Rosen, but later chapters will throw light on the realism or otherwise of these assumptions. In the meantime it must be noted that Rosen's paper does not in any way add to, or subtract from, our confidence in Waugh's findings.

THE HOUTHAKKER-THIEL APPROACH

Thiel (1952) and Houthakker (1954) presented an approach which analyses a situation where someone decides first what group of goods someone wants to buy then what good within that group. While many people would think this is realistic, Thiel is apologetic:

> "No doubt this case is a highly simplified one but sometimes it has a
> certain degree of reality e.g if a soldier decides to spend his 'income'
> on cigarettes only, then he has the choice of buying a large quantity
> of cheap cigarettes or a smaller quantity of more expensive ones".
> (1952, p.155).

The theory uses a homogeneous good within a group of goods.[16] The buyer decides, first, whether to buy in the group and then which good to buy in this group. Clearly

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[16]   The terms "good" and "group" are used here in Lancaster's sense, to avoid the confusion that would arise of Thiel's terms "qualities" "commodities" etc. were used.

the result of the analysis depend on whether, for example, butter and margarine are seen as goods in the same group, so both Houthakker and Thiel give some attention to what is a group. An elasticity of demand with respect to price paid is calculated.

In an extension of this, Thiel suggests defining a good by its characteristics and attributes. Characteristics are positively valued and their price is related to the cost of production. By implication a characteristic in one group of goods is not equivalent to the same characteristics in another, sugar in sweets or in puddings for instance.

The implications of using different types of characteristics or subjective attributes on the validity of the model do not appear to have been analysed, but it seems to be recognized that the model is at least easier to operate when it is specified in terms of quantitative characteristics like those in the Lancaster model.

LADD AND ZOBER

Ladd and Zober (1977) produce a theory which follows Lancaster's and is a reaction to it.

Like Lancaster they do assume that everybody sees the same objective characteristics, that a consumer has a fixed income that can be spent on products and that it is spent to maximize utility. They assume infinitely divisible products. They are concerned with consumers' reactions to objective measurable characteristics, not to perceptions or beliefs which may or may not affect sales.

Unlike Lancaster they do not assume:
-       every characteristic has non negative marginal utility (NNMU)
-       utility is independent of the distribution of characteristics among produce (IDC); and
-       linear consumption technology (LCT).

In contrast to the Lancaster theory, it is assumed that the consumer consumes products by consuming services (rather than characteristics) provided by the products. For example the width of an automobile can contribute consumption services including seating room, style and riding comfort. It is not necessary for their theory that it should be possible to identify the services in order to apply the model.

They use the model to determine whether in particular cases Lancaster's NNMU, IDC and LCT assumptions hold, whether the boundary assumptions hold in any case. The data used is the results of market level hedonic studies following Waugh.

Ratchford (1979) convincingly criticized the idea that one could determine the behaviour of individuals from market level data and hedonic studies. He also made further criticisms of Ladd and Zober, which were replied to in Ladd and Zober (1979a, b). Ratchford also presented his own analysis, again inspired by Lancaster but differing from it in many respects. For example, it does not have infinitely divisible goods, it uses characteristics and attributes interchangeably, it has a different consumption technology matrix, it has linear utility functions, and the possibility of economy sized packs is considered. The impact of these major changes to Lancaster are not worked out. The fundamental assumptions on supply and demand remain the same. In the discussion that followed both sides made a lot of interesting points, but at the end there is no clear rigorous model of the kind produced by Lancaster.

BECKER'S HOUSEHOLD PRODUCTION APPROACH

Historically, Becker (1965) is, with Muth (1966) and Lancaster (1966), one of the founders of the "new" theory of consumption.

> "Becker's particular contribution to the "new" theory of consumption was his emphasis on time allocation and the wage rate as the alternative cost of time used in household production. This led him to several interesting suggestions for application of the approach, although he did not pursue the empirical implications for the properties of demand functions in a rigorous way". (Sandmo, 1993 p13)

While Becker (1975) is fairly close to Lancaster, later developments (e.g. Michael and Becker, 1975; Stigler and Becker, 1977) concentrate not on an individual's choice, but on a reformulation of consumer theory into household production theory which

> "transforms the family from a passive maximizer of the utility from market purchases into an active maximizer also engaged in extensive production and investment activities . . . they maximize a utility function of objects of choice, called commodities, that they produce with market goods, their own time, their skills, training and other human capital and other inputs." (Stigler and Becker , 1977 p77)

Stigler and Becker (1977, p77) put forward "the proposition that one may usefully treat tastes as being stable over time and similar people." For example, they put forward a model of addiction which explains apparent changes in musical taste as constant taste plus investment in learning to appreciate a different style. Changes in fashion are discussed as a constant desire for the social distinction of being someone

83

who has "alert leadership, or at least not lethargy, in recognizing and adopting that which will win due time be widely approved." West and McKee (1983) discuss this approach and alternatives and come down broadly in line with Stigler and Becker.

Deaton and Muellbauer (1980 p244) comment "Our only qualm is that, when the intervening variables are not observable, there may be little cutting edge to the distinction between preferences and constraints, and the 'explanations' offered by the approach can sometimes be complicated ways of making simple points." which appears to be a mimimalist expression of the view that the approach is non-operational. Certainly it appears that Lancaster rather than Becker is used in empirical work.

DIXIT AND STIGLITZ

Dixit and Stiglitz (1977) tackle a welfare economics problem

> "The basic issue concerning production in welfare economies is whether a market solution will yield the socially optimum kinds and qualities of commodities". (p297)

They are mainly concerned with scale economies. They use indifference curves similar to those used by Lancaster, positive costs of characteristics and economies of scale in producing any variant. Unlike Lancaster they use a representative consumer.

Lancaster (1990) cites Spence (1976) and Dixit and Stiglitz (1977) as having a single representative consumer who buys some of each product, unlike his own approach. Market demand is then a matter of aggregating this consumer's purchases.

MONOPOLISTIC COMPETITION

There is a literature examining quality issues under monopolistic competition, where a price change or product change has an effect on all products in the group. Some also discuss oligopoly and monopoly. I know of no such models which are attempts to examine real products in real markets. The method is rather to take economic models of consumer demand and of production costs of the sort described above, to aggregate the results and then to build models of monopolistic competition. These are then used to examine the welfare implications of the situation modelled, the optimum product variety, or whether there is too much variety under imperfect competition under monopolistic competition. Typical work in this tradition is Lancaster Five, Dixit and Stiglitz (1977), Spence (1976), Hart (1985, a,b) Perloff and Salop (1985).

The value of such analyses depends on the generality of their application.

Chamberlin's original work is readily applicable to a large number of real markets, and Chamberlin's (1953) is a rich analysis of quality problems in the real world, an analysis which has been largely ignored, possibly because it raises points not normally incorporated into generalized mathematical models. The new models, sometimes referred to as neo-Chamberlinean, can only have an application if their assumptions on individual consumer demand and individual producer supply have some realism. In that sense the models must be considered as users of basic consumption theory, rather than theory in its own right.

Lancaster (1990) uses product variety in a way quite different to that of Chamberlin, rather like Chamberlin's product differentiation. A product variety, approximates to a brand or a model within a product group, to the "good' of Lancaster One in fact. His perspective is

> "Implicit or explicit theories of product variety are to be found at various points in economics, management theory, and marketing. In each context the view of product variety and the kinds of questions being asked about it are rather different from those in others. In economic theory, for example, the emphasis placed by a general equilibrium theorist is on the socially optimal degree of product variety, given some welfare criterion, and on the relationship of the degree of variety generated by the market on this. Economists primarily interested in market structure theory will tend to emphasize competitive relationships, product differentiation and product variety as decision variables for the firm, and the types of market equilibrium that result." (Lancaster 1990, p189).

THE SUPPLY SIDE

HEDONIC STUDIES

In market-level hedonic studies the supply side must be examined as well as the demand. In studies of the motor car market, it was normal to assume that oligopsonistic producers charged cost-plus for add-on components and had a perfectly elastic supply. Their costs would be similar when they bought from the same supplier. This assumption results in a situation where the supply price of a characteristic is related to its cost of production.

In Waugh's model of a vegetable market it may not be too much of a simplification to assume random fluctuations in supply. Supply is strongly determined by factors which cannot be controlled, like weather, disease, producers' guesses at which is the

optimum time to harvest and producers' guesses at which wholesale market would have the highest prices that day. One might assume that the mix of qualities on the market remained constant from day to day or, less convincingly, throughout the season. Even so, modern horticultural economists would take into account aspects like the marginal costs of harvesting and marketing vegetables in the very short term as factors affecting the supply of the lower grades, and the degree to which other production costs might influence supply in the longer run.

In the hedonic literature, therefore, we have at the two extremes a situation where the price of a characteristic is directly determined by its cost of production, and one where it is possible to ignore the cost of production entirely for most purposes.

ECONOMIC MODELS

With the models based on economic man the supply side is much more difficult to handle. Lancaster One and Two simply ignored it. Lancaster Four and Five and Rosen tackle it by first assuming a producer supply function and then assuming a very simple market structure. Ladd and Zober, (1979 a,b) present a case where a negative implicit price for a characteristic does not imply a negative marginal supply price for the characteristic, as assumed by Rosen (1974) and Ratchford (1979). They cite the case where the characteristics of an automobile - head room, leg room, seat height and window room - are constrained by another characteristic, exterior height.

COSTS OF QUALITY

I know of no models of the cost of producing quality which claim to be derived from the experience of firms operating in the real world. This is not to say that real-world economists have never examined the relationships, but rather that their results have never been incorporated into a research programme. This may be partly because in agricultural markets the link between production costs and price of characteristic is tenuous, and partly because empirical results are inconvenient to the theoretician: with tobacco for example, high quality tends to be associated with high yields and low unit costs.

Economic models do not seem to have taken into account the literature produced by quality control engineers which at first sight appears to flatly contradict economic theory with statements like "Quality is Free" (Juran 1979). This argues that a firm can reduce its unit costs by spending more on reducing the amount of poor quality produced at the beginning of the production process, and so reducing the costs of rejection, rework and repair under guarantee at a later stage in production. On examination, however, this proves to mean no more than that it is cheaper to produce efficiently than inefficiently. In economic analysis it is normal to assume that a firm

is producing efficiently and then to examine the impact of changing inputs or methods to produce at another level. The fact that an inefficient firm can reduce unit costs by spending more on an input, whether it be fertilizer or a quality assurance consultant, does not imply that the input is free.

There are many discussions of "cost of quality" and what the British Standards Institute refers to as "The Economics of Quality" (e.g. Plunkett and Dale 1988, Oakland 1989, Robertson 1971, Caplan 1972, Kirkpatrick 1970, Harrington 1976,. BS 4891, BS 4778, BS 6143, Thoday 1976, Besterfield 1979 Juran and Gryna 1980, Campanella and Corcoran 1983, Veen 1974, Kohl 1976, Huckett 1985, Lockyer 1983). These approaches are quality assurance engineers' approaches and I am not aware of any publication on them in the economic literature. Elsewhere (Bowbrick 1992) it was shown that there is no common interpretation of the axes of the standard paradigm diagram. It was also shown that, depending on how the concepts were defined, a great many different shaped curves could be drawn, bearing no relationship to those in the literature.

Garvin's (1988, p82) search of the literature concluded "The data on quality costs . . . is largely anecdotal, often accounts by companies wishing to publicize successful quality programmes" and Plunkett and Dale (1986) report that in two comprehensive literature searches "it was noted that there is virtually no information available on the costs or economics of common quality-related engineering practices."

MARKETING

The approaches discussed in this section are ones that are widely used in marketing but are not part of mainstream economics. Marketing economists, sitting in the middle, recognize their existence but seldom use them. This is partly because the approaches do not fit easily into market level studies, and partly because of their cost. The very factors that make market level analysis possible and powerful in agriculture mean that agricultural economists seldom have the sort of resources available for experiment that people marketing heavily branded goods like sweets would have.

COMPENSATORY MODELS

In marketing, multi-attribute attitude models are widely used. These are compensatory in the sense that good evaluations on some attributes may compensate for poor evaluations on others. (The term "attribute" is used in marketing where "characteristic" is usually used in economics. However, marketing tends to address both subjective attributes and objective characteristics, so the use of "attribute"

usually conforms to the convention used here).

The basic linear compensatory model is one where the consumer's <u>attitude</u> score for a brand is a function of his or her belief in the amount of an attribute in that produce and the importance weight that he or she gives to that attribute. (Wilkie and Pesseimer, 1973, p.429). More complicated versions have been developed notably by Fishbein and Ajzen (1975). Clearly these approaches require that individuals are asked to explain their beliefs.

There are a large number of such models in the literature and they have been estimated in different ways. The results have been very variable, and it seems that the most one can say of any of them is that it works when it works.

There are two approaches to getting the information required for these models. The first is the <u>compositional</u>, where the consumers explains how they reach their evaluation from the bottom up. For example they may explain to the researcher the perceived attribute level of alternatives and the associated value rating (e.g. Green and Srinivasan 1978); they may explain their beliefs about the level of attribute, the weighting they would give and the summing of these (e.g. Fishbein 1963) or they may state the level of each attribute and the relative importance of each attribute.

The decompositional approach starts with individuals' evaluations of alternatives and then works out a possible evaluation system that could explain this. This is an approach used by traditional conjoint systems (e.g. Green and Wind, 1973).

Huber has developed a hybrid approach using both approaches (e.g. Huber, 1974, Hoepfl and Huber 1970).

The next step from any of these approaches is to combine the results of the sample individuals in the hope that they will be consistent and representative.

Akaah and Korgaonkar (1983) did an experiment comparing the three approaches. The approaches could not be tested for predictive accuracy, what the individual or the market actually bought. They could be tested for what an individual thought he would have bought - after going through the long process of thinking implied in completing the questionnaire. Their results, when combined with other studies they cite, suggest that each of the different approaches seem to give a better fit for different products in different markets. There is no way of deciding which is most likely to give a good fit. The choice is likely in practice to be made on other factors: self explicated models are faster, easier, and less strain on respondents, while conjoint models are easier to manipulate mathematically.

THE PERCEIVED QUALITY APPROACH

There is a great deal of evidence in the marketing literature that:

    a)   Consumers' perception of characteristics is subjective and may differ significantly from the subjective. Their actions depend on their subjective impressions (which are termed attributes here) rather than the objective characteristic.

    b)   Consumers have some method of combining their subjective impressions of characteristics to produce a subjective impression of quality. This may be the quality of the final product, the car, or of intermediate attributes like comfort, road holding and performance.

    c)   Individuals vary in their perceptions and the heuristics they use.

Steenkamp (1989) provides a review of the literature on this and develops a model to describe how consumers can form judgments about product quality. He then tests his model. His model is of a perceived quality that (1) involves preference, (2) involves a subject-object interaction, (3) is relativistic in that it is comparative, personal and situational, and (4) resides in the consumption of the product. The aim of the study was to explain

> "For example, some [previous] studies reported a significant effect of packaging on overall perceived quality but failed to explain why this effect occurred. With the present approach, we are able to explain the effect of packaging through the intervening role of the quality attributes, sensory perception and keepability." (page 245)

Such studies attempt to relate consumer purchase decisions to perceived quality and eventually to objective characteristics. Inevitably, though, if there is any great difference between perception and reality, and particularly if individuals differ, there must be problems in aggregation and disaggregation which are assumed away in the economic models.

PSYCHOLOGICAL APPROACHES

There are several approaches to consumer choice which make use of psychology in order to develop more realistic models of consumer choice.

Behavioral economists try to find out how people really do make their decisions, in order to build realistic choice models for a given situation. They may use questionnaires and interviews to find out how people think.

The behaviorists follow in the footsteps of Watson and Skinner and analyse behaviour in terms of people's response to stimuli. It may be argued, by Earl (1990) for instance, that this approach may be more appropriate than the behavioral for the analysis of routine decisions using habitual processes to analyse limited information, where, for example, people carry on buying a brand as long as they get positive reinforcement. It is less appropriate where people think carefully before making decisions, or for analysing new products or new markets. The behaviorists can easily fall into the error of confusing cause and effect or of using the wrong characteristics in the model, because they are not concerned with how decisions are made, rather with what decisions are made.

HEURISTICS

Heuristics are decision rules used by the consumer, rules which may be, but are not necessarily, optimizing or rational. The production economics approach gives a maximising heuristic for a chicken farmer mixing his own feed. Unlike most of the heuristics covered in the theory of consumer choice, this is normative and optimizing and it is used in practice.

The economic models develop heuristics which are intended to maximize utility (Lancaster's heuristic is similar to the production economics one). These are not normative: while there is a suggestion that utility maximizers would adopt such a system, there is no implication that they should. At the same time, there is no suggestion that many people act in the way described. The implication would appear to be that, as with much of economic theory, it is safe to act on the assumption that people are profit maximizers, and that deviations will cancel each other out.

The more subtle heuristics of economic theory, like satisficing rather than maximizing, are not included in economic man approaches to quality. Search models do however argue that when people are searching for the optimal price and sometimes quality, they will trade off the cost of further search against the desire to get the best bargain. These are optimizing models, taking search costs into account.

Of course there is no reason to believe that people will adopt the logical, of optimizing heuristics of the models. Others are widely used. There has been a lot of psychological research on how people make decisions (e.g. Nisbett and Ross, 1980; Kahneman, Slovic and Tversky (1982). This shows that they often use a range of heuristics that are most certainly not optimizing, and which might be termed irrational, e.g.

Reference present effect
Sunk cost effect

Endowment effect
Framing effects
Availability bias
Representativeness bias
Opportunity cost effect
Certainty effect

Most of the experiments were designed to rule out the sort of information seeking and search considered normal the economics of information, and the possibility of learning by experience, so the results may not have wide application in real-world economics.

MARKETING ECONOMICS

Marketing economics is an approach which is characterized by a broad consensus on what the problems are, rather than by an agreement on what assumptions to use or what techniques can be applied. It makes use of whatever theories or techniques seem to be most appropriate to the problem. In this it is like some other disciplines:

> "Neurophysiology, physiology, and certain parts of psychology are far ahead of contemporary physics in that they manage to make the discussion of fundamentals on essential part of even the most specific piece of research. Concepts are never completely stabilized but are left open and are elucidated now by one, now by the other theory. There is no indication that progress is hampered by the most 'philosophical' approach which, according to Kuhn underlies such a procedure ..... (Thus the lack of clarity about the idea of perception has led to many interesting empirical in investigations, some of them yielding quite unexpected and highly important results ...) Quite the contrary, we find a greater awareness of the limits of our knowledge, of its connection and human nature, we find also, a greater familiarity with the history of the subject and the ability not only to <u>record</u> but to <u>actively use</u> past ideas for the advancement of contemporary problems. Must we not admit that all this contrasts most favourably with the humourless dedication and constipated style of a 'normal' science?" (Feyerabend, 1970, pp.198).

Certainly agricultural marketing economists produced some of the earliest work on product quality, from Waugh (1928, 1929), Waite (1934), Norton (1939) and Raeburn (1939). The hedonic approach descends from this work. Lancaster's work too descends from an agricultural economics tradition, this time one derived from the least-cost feed problems of the production economists (e.g. Stigler, 1945; Cornfield, 1941; Gorman, 1956). Ladd's work comes from an agricultural economics tradition.

Some work like that on grading and minimum standards remains largely in agricultural economics, because the problems loom large with agricultural products but are less obvious with industrial products.

Marketing economists generally see quality in a market context and seldom consider it safe to analyse individual preferences and actions without examining the market effect, the effect of aggregate supply and demand on prices for instance. Various papers in the discipline relate quality prices to the factors covered in Table 4.1, though of course there are few situations where they are of key importance, or where it would be feasible to cover them all. In the economic man approaches and to a lesser extent, in marketing approaches, these complications are implicitly assumed away.

TABLE 4.1: SOME FACTORS AFFECTING QUALITY PRICE

SUPPLY   PRODUCTION ECONOMICS
                    Costs of producing different characteristics mixes at different levels of output.
                    Supply curves of individual firms.
                    Gross margin, joint products, multi-product production.
                    Market period, short run, long run.
                    Variations in quantity produced.
                    Variations in quality produced.
                    Perceptions of present and future costs, future quantities.
                    Reliability, consistency, tolerances, adherence to specification.
                    Grading.
                    New products.
                    Intermediate products.
                    Alternative production technologies.
                    Validity of aggregation.
              MARKETING ECONOMICS
                    Number of firms, market structure
                    Substitution, alternative products.
                    Attributes or characteristics.
                    Grades, Brands.
                    Location.
                    Imports, exports, alternative markets.
                    Information, cues
                    Search
                    Wholesaling, retailing, transport and distribution.
                    Elasticity
                    Aggregation
QUALITY PRICE

           Quality price
           Hedonic price
           Reporting methods
           Relationship of price to market environment
           Statistical validity

DEMAND
    MARKETING ECONOMICS, MARKETING
        Subjective, objective
        Grades, brands
        Brand loyalty, repeat buying
        Number of product lines on the market
        Substitution, cross elasticity..
        Segments.
        Elasticity.
        Monopsony, number of firms, differentiation.
        Price as indicator of quality.
        Alternative sources of supply
        Alternative products, product lines.
        Special prices
        Search, information, cues.
        Market period, short run long run.
        Learning.
        Dynamic price formation.
        What people buy.
        Long term and short term decisions.
        Purchasing strategies.
    PSYCHOLOGY
        Why people buy.
        Deviation between purchases and preferences.

    CONSUMPTION THEORY
        What people ought to want to buy.
        How consumers ought to appraise quality.

Agricultural marketing economists are interested in such problems as what quality should farmers produce to get higher prices? (which may be tackled by hedonic studies, or by consumer level studies such as those by Steenkamp (1987), Baron (1976,1984), Baron and Eagle (1981)). Other problems tackled include, What system will communicate consumers' quality preferences to producers? (e.g., carcass classification systems, grading systems, labelling systems); Can producers' prices be raised by destroying certain qualities of product?, Can producers' prices be raised by

compulsory minimum standards?

This research programme tends to see things from the perspective of a producer who sells into a marketing system. Accordingly, much of the work deals with the price farmers get at the first or second stage of the marketing systems, at assembly markets, processing plants or terminal markets for instance. There is also an understanding that quality is not just something the consumer wants: distributors have a demand for quality which may or may not be correlated with consumers' demand. In quality studies of the meat and livestock industries, the characteristic of "cutability" (the percentage of saleable meat from a carcass) is of primary importance to retailers' profits even though it is not a factor that the consumer even gets to hear about. This distributors' quality characteristic is brought into models of wholesale and farm gate prices alongside characteristics of interest to the consumer (e.g. Biggs, 1975; Chabluk and Beaton, 1985; Daumas, 1987; Dawson, 1982; Freedon, 1970; Griffith and Giles 1977). In horticulture, too, some characteristics like uniformity and waste levels are very important but the consumer never gets to know about them, so a classification system that is meaningful at wholesale may be meaningless at retail (Bowbrick, 1981, 1982; Bowbrick and Feeney, 1981). Similarly, it may be argued that some of the benefits of brands are felt by retailers, but not by consumers (Bowbrick, 1992). Some of ways in which retailers benefit from quality can be accurately quantified, others not. Others still are largely derived benefits: the retailer gets increased sales if the consumer likes his product. This means that models of consumer choice processes, whether those of household production theory or of attitudes and perceptions, may not seem terribly relevant at this stage. Even if the demands were purely derived demands, the complexities of most real-world markets (see Table 4.1) would make it virtually impossible to derive wholesale market prices from what consumers believe.

In agriculture it is never possible to produce to an exact specification. Each producer produces a range of qualities, and the market generally has a wider range still. Practical marketing, therefore, requires grading (which Bowbrick (1982) has broken into sorting, classification, pricing, labelling or some combination of these), and the economics of grading has been an important part of the agricultural economics (e.g. Waugh, 1928, 1929; Jesness, 1933; Waite, 1934; Norton, 1939; Ashby, Webb, Hedlund and Bull, 1941; Anderson and Enomoto 1982, Anderson 1980, Bartlett, 1970; Bauer and Yamey, 1954; Bowbrick, 1974, 1976a, 1976b, 1979, 1981, 1982, 1992; Brandt and Junqueira, 1969; Chivaher, 1985; Dalrymple, 1968; Ekstein, Sharon and Illan, 1974; Erdman, 1950; Farris, 1960; Freebairn 1967, 1980; Kiel and Rhodes, 1956; Lambert, 1980; Lassaut and Sylvander, 1981, 1984; Leusie, 1980; Lloyd-Brown, 1986; Mehren, 1961; Meulenberg, 1973; Nunziante, 1962; Nybroten, 1953; Paroush, 1978; Rhodes and Kiel, 1956; Rieff, 1975; Schaffer, 1979; Shaw, 1961; Southworth, 1956; Veall, 1985; Williams, 1961, 1962, 1964.)

The fact that industrial products do vary, and are not of point quality, is usually

assumed away in household production theory and marketing theory, but it is the main area of concern in quality control and quality assurance, and in the economics of information and risk, as well as being important in agricultural economics.

One important strand in the economics of grades was the use of grading standards as a method of reducing supply and so putting up prices. This has a different effect to the effect when there is a reduction in supply when the product is homogeneous. This line of research as been particularly important with regard to American marketing orders (e.g. French, 1982; Jesse and Johnson, 1981; Jesse, 1979, 1981; Myberg, Lombard and Sinclair, 1986; Polopolos, Carman, Jesse and Shaffer, 1986; Price 1967a, 1967b, 1968; Ward, 1982; Waugh, 1971, Nguyen and Vo, 1985, Nichols, 1972).

The use of compulsory minimum standards when safety was not involved was attacked by Bowbrick (1977, 1981), Bockstael (1984), Carley (1983), and justifications for minimum standards in other circumstances was discussed by Bowbrick (1989), Blight (1986), Cohen, Porter, Reed, Sharp, Forbes and Paterson (1983), Curtin (1984), Gilles (1987), Gold and van Ravenswaay (1984), McNiel (1980, Bauman (1976) and Holmes (1986).

An important role of grades is to transmit information, and there is an extensive literature about the use of labelling in this respect, usually in conjunction with classification or sorting (e.g. Bowbrick 1981, 1982; Beck, 1967; Billebault and Guichard, 1987; Boynton, Blake and Uhl, 1983; Devine and Marion, 1971; Devine, 1978, Lenahan, Thomas, Taylor, Call and Padberg, 1973; Marks, 1984; McCartney, 1980; Miller, Tepel and Rust, 1976; Perloff and Salop, 1980, 1986; Perloff and Rausser, 1983; Riordan and Connolly, 1976; Smith Brown and Weimer, 1979; Banks, 1963; Cable 1974, Keane and Riordan, 1972-3). It is also recognized though that sorting without labelling, branding without labelling or limited classification can also communicate information effectively (Bowbrick, 1982, 1992).

Sorting is another aspect of grading, which is obviously practiced in horticulture, and less obviously with some other agricultural products. It is also a part of many industrial processes, and some quality control processes are simple sorting processes. The quality of the output of a sorting process depends on the definitions (is a grade defined by its upper or lower limits or by the average level of characteristic for instance?), by the permitted tolerances and their definitions, by the sorting process, and even by the sequence of the different sorting processes carried out (Bowbrick 1982). Given the potential importance of this it is surprising how little has been written on this: the main references are Makov and Zusman (1967), Zusman (1967), Zusman and O'Regan (1971), Conniffe (1976), Matsumato and French (1971) and Nichols, Powell and Branson (1977).

The problems tackled by marketing economists are clearly a lot more complex than

drawing up models to describe the purchasing behaviour of individuals buying products of point quality. The marketing models they use when doing hedonic studies have to be reasonably realistic, and complex. It follows that it is not possible to produce a textbook model that can be used in all situations, where all the researcher need do is insert the data for his particular market to get a prediction.

LITERATURE ON LANCASTER

This section examines the literature on Lancaster's theory. A complete search of the Social Science Database of the Information Institute of Scientific Information Limited was carried out to provide an objective listing of the publications that were most often cited by people using his theory. The expected outcome was that while Lancaster was the basic reference in the approach, the theory would have been developed by perhaps ten other economists who developed a new, more rigorous, more widely applicable paradigm which was generally accepted. This proved not to be the case : Lancaster's paradigm cases are the ones generally used.

In the period 1987 to 1992, 273 papers in the database are of Lancaster's key publications (1966, 1971, 1979). These cited 9,988 publications. The number of times these were cited is shown in Table 4.2 and Table 4.3.

TABLE 4.2

PUBLICATIONS MOST OFTEN CITED IN PAPERS CITING LANCASTER (1966, 1971 OR 1979)

Times cited

167   **Lancaster, K.J.**, "A new approach to consumer theory", *Journal of Political Economy*. 74   132-157. 1966.

81   **Lancaster, K.J.**, *Consumer demand: a new approach*. New York. 1971.

77   **Lancaster, K.**, *Variety, equity and efficiency*. Columbia studies in Economics no 10. New York and Guildford. Columbia University Press. 1979.

45   **Becker, G.S.** "A theory of the allocation of time". *Economic Journal* 75:493-517, 1965.

37   **Hotelling, H.**, "Stability in competition", *Economic Journal*. 39   41-57. 1929.

33   **Chamberlin, E.H.,** *Theory of Monopolistic Competition,* Cambridge Mass. Harvard University Press, 1933. 5th Edn. 1946.

29   **Rosen, S.**, "Hedonic prices and implicit markets: product differentiation in pure competition", *Journal of Political Economy.* 82 34-5. 1974.

25   **Dixit, A.R. and Stiglitz, J.E.**, "Monopolistic competition and optimum product diversity", *American Economic Review*. 67 298-308. 1977.

22   **Deaton, A., and J. Muellbauer**, *Economics and Consumer Behaviour*, Cambridge, Cambridge University Press, 1980.

20   **Salop, S.C.,** "Monopolistic competition with outside goods", *Bell Journal of Economics*. 10, 141-156, 1979.

18   **Griliches, Z.**, (ed) *Price Indexes and Quality Change,* Cambridge, Mass., Harvard University Press, 1971.

14   **D'Aspremont, C., J. Gabszewicz and J-F. Thisse**, "On Hotelling's `Stability in Competition'" *Econometrica* 47 1145-1150, 1979.

13   **Green, P.E. and V. Srinivasan**, "Conjoint analysis in consumer research:

issues and outlook", *Journal of Consumer Research.* 5 (Sept) 103-123. 1978.

12   **de Palma, A., V.Ginsburg, Y.Papegorgiu and J-F.Thisse**, "The principle of minimum differentiation holds under sufficient heterogeneity" *Econometrica* 53, 767-81, 1985.

Marshall, A., *Principles of Economics,* London, Macmillan, 8th Edn 1920

McFadden, D., "Conditional logit analysis of qualitative choice behaviour", in Paul Zarembka (ed) *Frontiers in Econometrics,* New York, Academic Press, 1973.

Ratchford, B.T., "The new economic theory of consumer behaviour: an interpretative essay", *Journal of Consumer Research.* 2 65-75. 1975.

Spence, M., "Product differentiation and welfare", *American Economic Review,* 66, 401-14, 1976.

Stigler, G.J. and G.S.Becker, "De gustibus non est disputandum", *American Economic Review.* 67 76-90. 1977.

11   **Grubel, H.G. and P.J.Lloyd**, *Inter-industry trade: the theory and measurement of international trade in differentiated products*, London, Macmillan 1975.

Muth R.F., "Household production and consumer demand functions", *Econometrica*, 34:699-708, 1966.

10   **Gronau, R.,** "Leisure, home production and work - the theory of allocation of time revisited" *Journal of Political Economy* 85, 1099-1124, 1977.

Hauser, J., and P.Simmie, "Profit maximizing perceptual positions: an integrated theory for the selection of product features and price", *Management Science*, 27, 33-56, 1981

Hauser, J.R. and S.M.Shugan, "Defensive Marketing Strategies", *Marketing Science* 2 319-360, 1983.

Krugman, P., "Increasing returns, monopolistic competition and international trade" *Journal of International Economics* 9, 469-79, 1979.

Krugman, P., "Scale Economies, product differentiation and the pattern of

trade," *American Economic Review* 70(5) p950, 1980.

Shocker, A.D. and V. Srinivasan,, "Multi-attribute approaches for product concept evaluation and generation: a critical review", *Journal of Marketing Research.* 16 [May] 159-180. 1979.

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29   **Rosen, S.**, "Hedonic prices and implicit markets: product differentiation in pure competition", *Journal of Political Economy.* 82 34-5. 1974.

25   **Dixit, A.R. and Stiglitz, J.E.**, "Monopolistic competition and optimum product diversity", *American Economic Review.* 67 298-308. 1977.

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18   **Griliches, Z.**, (ed) *Price Indexes and Quality Change,* Cambridge, Mass., Harvard University Press, 1971.

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Management Science, 27, 33-56, 1981

Hauser, J.R. and S.M.Shugan, "Defensive Marketing Strategies", *Marketing Science* 2 319-360, 1983.

Krugman, P., "Increasing returns, monopolistic competition and international trade" *Journal of International Economics* 9, 469-79, 1979.

Krugman, P., "Scale Economies, product differentiation and the pattern of trade," *American Economic Review* 70(5) p950, 1980.

Shocker, A.D. and V. Srinivasan,, "Multi-attribute approaches for product concept evaluation and generation: a critical review", *Journal of Marketing Research*. 16 [May] 159-180. 1979.

This shows a striking pattern. Only Lancaster himself, and four other publications are cited in more than 10% of papers, and only twelve publications are cited in more than 5% of papers. Some of those cited are precursors to Lancaster which are cited for the sake of completeness but are seldom used in their own right e.g. Becker (1965) 45 citations; Gorman (1956, 1980) 8 citations; Ironmonger (1972) 6 citations; Muth (1966) 11 citations. Others are alternative approaches e.g. Hotelling (1929) 37 citations; Rosen (1974) 29 citations; Dixit and Stiglitz (1977) 25 citations; Griliches (1971) 18 citations.[17]

Some are bowing to the great e.g. Chamberlin (1933), Marshall (1920), Hicks (1966). Some refer to econometrics texts and to papers importing an econometrics technique to the analysis (e.g. McFaddean, 1973). Some are important in one particular application like location analysis (e.g. Alonso, 1964 cited seven times). Some are cited up to half a dozen times mainly because of self citation, some are textbooks or literature reviews e.g. Deaton and Muellbauer (1980) 22 citations; Ratchford (1977) 12 citations.

If these publications are removed from the list, we are left with very few publications indeed that are within the Lancaster tradition and are cited by as many as 5% of the people citing Lancaster. This implies that Lancaster's own theory remains the paradigm case.

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[17]   The possibility must be considered that many of the papers citing Lancaster are in fact working in another approach, and are citing Lancaster as an alternative approach that was not used. However, with only 29 papers citing Rosen, and 10 citing Houthakker, the effect is small.

At the other extreme, it is surprising that papers which I consider important and which are widely cited in other traditions are cited only two or three times or not at all. Chamberlin (1933) <u>Monopolistic Competition</u> for example is cited 33 times as general background, but Chamberlin (1953), which is sharply relevant, is cited only three times, in one per cent of papers.

It is surprising too how seldom papers that criticize Lancaster are cited : Hendler (1975), Lucas (1975) and Ladd and Zober (1977) are cited only 6 times, in 1.5% of papers. While it is conceivable that they might have been read and their arguments given little weight, they are not trivial or badly written and it is worrying that they should have been ignored.

CRITICISMS OF LANCASTER

The commonest criticisms of Lancaster are set out in this section. Many of the limitations are stated explicitly by Lancaster himself, but his critics set out the implications.

Non-Linearity in Consumption Technology

Lancaster's terminology is confusing here: linearity in consumption technology only means that x times as much of the product produces x times as much of the characteristic; it does not mean that it gives x times as much utility. The main problem that it implies an infinitely divisible product, which is extremely rare in practice. The theory cannot handle products like automobiles, or even sugar sold by the kilogram, satisfactorily (Rosen 1974, Ratchford 1979).

A Characteristic gives the Same Utility Whatever the Product

Acetic acid in vinegar gives the same utility as acetic acid in wine, under this assumption. Lancaster Two tackles this weakness by defining groups and defining their key characteristics in a highly specific, <u>ad hoc</u>, manner. Lucas (1975) considers this the weakest aspect of Lancaster's theory.

Objectively Measurable Characteristics

This assumption rules out socio-psychological aspects which have no direct relationship with physical characteristics, as well as taste (Steenkamp 1989, Ladd and Zober 1977 p80).

Perfect Information

Lancaster (1971) mentions the problem, as does Steenkamp (1989). There is no analysis of the implications.

Deterministic Model

The model implies that the customer will always choose the same good. The importance of variation is shown by McAlister and Pesseimer (1982), Wierenga (1984), but not in relation to Lancaster.

The Mixability Assumption

The assumption that a given mix of characteristics always gives the same satisfactions, whatever mix of goods the product is obtained from, is considered unrealistic by Ladd and Zober (1977).

Negative Marginal Utilities

Lancaster recognizes the problem that some characteristics have a negative marginal utility and suggests that this is easily tackled by changing the scale to "The absence of x". Hendler (1975), Ladd and Zober (1977), Steenkamp (1989 p31), Ratchford (1979) all consider this an important flaw in the model. However Hendler (1975) does present an adjustment to Lancaster's approach which Ratchford (1979) considers adequate, but Ladd and Zober do not.

There are also criticisms from outside the paradigm:-

Ignorance and Uncertainty

Lancaster fails to deal with uncertainty and imperfect perceptions. "Considerations such as these call into question the 'objective' approach of Lancaster's model and the idea that it is safe to leave it to the analyst to decide where one should draw the dividing line between preferences and constraints" (Earl 1986 p35) (see also Steenkamp)

- "It may be a misleading approximation to theorize as if consumers can always perform or even bother to try to perform the kinds of multi dimensional trade offs that the (new) theory of consumer behaviour every bit as much as the 'old' one, assumes they carry." (Earl, 1986 p44).

Earl does not elaborate on the implications of these criticisms to the applicability of Lancaster, but goes on to present a rich alternative.

HENDLER'S CRITICISMS

Hendler (1975) argues that
> "if the assumptions of Lancaster's (1966, 1971) model are found to be more restrictive than those of the traditional approach, then it becomes only a special case, rather than a general theory of demand."

He proceeds to set out the restrictive boundary assumptions.

The assumption that the marginal utility of characteristics can never be negative is restrictive. It rules out the possibility that a characteristic may have been positively desired at some levels, negatively at others.
> "It is difficult to conceive of goods which do not possess characteristics with negative marginal utility while still yielding a net positive marginal utility to the consumer. The point at which it becomes negative is clearly subjective and depends on the consumer's preference function." (Hendler, 1975 p116).

Accordingly, Hendler presents a case where relaxation of the assumption of non-negative utility is relaxed, with one of the characteristics having a negative utility, and argues that
> "Relaxation of the NNU [non-negative utility] function will not alter Lancaster's model, it will only modify the shape of the efficiency frontier which may now have a positively sloped segment . . . The NNU assumption is not essential for the Lancaster approach."
> (Hendler, 1975, p196)

Hendler is on the verge of a major criticism here but misses it, presenting only a modification of the paradigm case. He recognizes that not everyone will agree that a characteristic is negative, and that people will not value a characteristic negatively at different levels of quantity. However, this implies that they have different efficiency frontiers and Lancaster's normalizing procedure based on a common efficiency frontier no longer works. Chapter 5 of this refutation examines the point in more detail.

Because Lancaster's model is derived from input supply models using linear programming, it effectively aims to maximise the quantity of characteristics with a budget constraint. This only maximizes consumers' utility under certain restrictive assumptions, either

1)   The utility independence of characteristics per unit : that utility depends on the total quality of a characteristic consumed and is not affected by the degree of concentration or in what product it is consumed.

2)   That two goods can be mixed to produce a third one.

Hendler raises points like the need to abandon ceteris paribus and boundary assumptions, introducing a time dimension, and the mixability assumption which implies

> "that the individual is indifferent to whether he consumes one very
> sweet apple and one without any sweetness (but otherwise identical)
> or two mildly sweet apples, as long as the sum of sweetness and all
> other characteristics is the same" [and that] "only inefficient
> consumers (or people who enjoy making them) would consume
> salads" (Hendler 1975 p198).

He argues that indifference curves of the type used by Lancaster are appropriate only if the point is obtained by consuming a single good (rather than mixing) when the UIC assumption is dropped.He concludes

> "The Lancaster linear combination line dc is a 'characteristics
> possibility frontier' rather than an efficiency frontier. Nothing can be
> said in terms of consumer efficiency unless the goods are known to
> be mixable or the consumer's utility function is given. The Lancaster
> efficiency frontier is objective only under certain restrictive
> assumptions. The 'new approach' thus becomes an interesting and
> important special case of consumer choice rather than a special
> model of consumer demand" (Hendler 1975 p199)

Hendler's paper is a powerful criticism of Lancaster's boundary assumptions and it is strange that it is not more widely cited, though it may be because he understated his case. Its criticisms of the non-negative marginal utility assumption result in a slight adjustment to the theory.[18]

LADD'S CRITICISMS

G. W. Ladd criticized Lancaster and offered alternative approaches in a series of papers: Ladd and Zober (1977), Ladd and Zober (1979 a, b) Ladd and Suvannant (1976) and Ladd and Martin (1976). The main criticisms are of boundary assumptions:

-       The non negative marginal utility assumption without which it is impossible

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[18]   "... Hendler (1975) shows that relatively minor modification [sic] of Lancaster's efficiency frontier concept to allow positively sloped segments at the edge of the characteristics space essentially preserves the Lancaster model." (Ratchford 1979 p78).

to judge a consumer's efficiency without knowing his preferences.

-        The assumption of linear consumption technology.

-        The assumption that utility is independent of the distribution of goods among characteristics.   Lancaster's model is only valid if each point in characteristics space represents a specific combination of characteristics and a unique level of utility.

Ladd and Zober also question
"the plausibility of a theory that assumes that utility is a function of product characteristics, when product characteristics are defined as 'objective properties of things' (Lancaster 1971 p6, and also pp114-116). It appears that these people would feel more comfortable with a theory that assumes that utility is a function of services rendered by products and that these services rendered are related to product characteristics." (1977 p90)

LUCAS'S CRITICISMS

Lucas (1975) makes similar points to other writers on the boundary assumption of Lancaster's model. He points out that problems can arise with discrete or integer characteristics (as does Lancaster (1971 pp107-8)). He points out problems with indivisibles. For example, with cars it is necessary to assume the choice of a car to be independent of the quantities of commodities chosen in all other classes of commodities. Lancaster's approach results in a situation where the consumption possibility curve for someone buying a single car is not the same as the curve that corresponds with exhaustion of the consumer's budget. Indeed, the curve becomes a set of vertex points, one for each car model on the market. With product separability, one has iso-expenditure curves as the product possibility curves, rather than income constraints. He concludes that the approach is not very suitable for such durables.

These limitations aside, the approach is compatible with hedonic analysis. He shows the importance of Lancaster's rejection of the single representative consumer, if a market situation of the sort usually assumed is to exist. He shows that there will normally be a non-linear hedonic function when different consumers are optimizing on different facets of the consumption possibility curve - and empirical work usually produces non-linear hedonic functions.

Lucas also shows that the hedonic price index approach of Adelman and Griliches is a special case of Lancaster, but that it does imply comparisons of interpersonal utility, and that a complication
"arises from the instability of the hedonic equation as new commodities are introduced, thus rendering Adelman and Griliches' definition of the poly-genetic

price changes ambiguous, depending on whether base or current period cross-sectional hedonic equations are employed."

WHY IS LANCASTER SO POPULAR?

Lancaster's approach remains the most influential in the economics of quality in spite of these criticisms. This is partly because the approach offers great attractions:

-        Lancaster's approach is rigorous in the sense that the two paradigm cases at any rate, flows logically from its assumptions. It is often not clear in other approaches what assumptions are made and one is often left wondering if the assumptions necessary to the theory have in fact been made explicit.

-        Lancaster's approach derives from the linear programming models of production economics, with which many economists are already familiar.

-        The Lancaster approach makes use of diagrams and mathematical models which economists are familiar with from earlier studies. Concepts like the indifference curve which they understand in other contexts are imported in such a way that neither Lancaster nor his followers question their applicability to quality problems. In a consumption theory textbook, Deaton and Muellbauer (1980), the Lancaster approach is fitted into the analysis built up on goods in previous chapters, again without any discussion as to whether the familiar analysis is applicable.

-        This clearly makes the theory more acceptable, but it will be shown in later chapters that the seamless join of Lancaster onto consumption theory is illusory.

-        His approach is presented as a fully integrated model, while most of the alternatives are presented as short papers or even a few equations in a paper - these may be good economics, but they are not user friendly. This does not, however, appeal to all economists: many would be totally opposed to the concept of an integrated model applicable to all products in all markets.

-        "One reason for the popularity of Lancaster's model is that he is able to reach a number of useful conclusions from a relatively simple analysis" Ladd (1980).

-        "...some conclusions can be drawn about competitive viability of brands without knowledge of individual utility functions, and his concept that a group of goods sharing common characteristics provides a definition of an industry" Ratchford (1979)

-       "... the basic concern of the firm is with price and volume sold in the market place and is not with consumers' reactions as expressed in studies of preferences, attitudes, loyalties, or conjoint studies". (Ladd and Zober, 1977 p89)

-       Alternatives, especially those taking into account attitudes or behaviour, are expensive in time and money. Hours have to be spent on interrogating each respondent.   Even when individual consumer behaviours have been modelled, it is not easy to aggregate these models into market demand.[19]

-       The economic models, including Lancaster's, provide a way for interpreting hedonic equations relating to the market.   Altitudinal, perceptual, behavioural, informational or satisficing models or heuristics approaches may explain individual choice, but they make disentangling the meaning of a hedonic equation very difficult indeed. As individual consumers might use several approaches simultaneously (information plus attitudinal) and there may be many heuristics in a given market, it may be asked whether disaggregation is possible.

-       "Lancaster's model ..... provide[s] knowledge of the way consumers react in the market place to the characteristics a producer puts into his products." (Ladd and Zober 1977 p89)

-       The model is clearly a workable, rational heuristic for mixing chicken feed.

CONCLUSION

In the context of this refutation we are interested in the wider literature on quality only in so far as it throws light on the basic research question of whether Lancaster's theory of consumer demand has a role in real-world economics.

The first conclusion is that there are many alternative approaches to quality, and there is no reason why an attempt should be made to rescue an unsatisfactory approach by introducing more ad hoc assumptions or using conventionalist stratagems. True, few of the alternative approaches have been subjected to serious testing, so there can be no more reason to feel confident in them than in Lancaster's theory. On the other hand they have received no serious criticisms.

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[19]   However, the implication of the criticisms of his unrealistic boundary assumptions are that it is necessary to do such studies to determine whether the boundary assumptions hold in any case. Only after this is it possible to proceed with the analysis of the characteristics.

This review has not suggested that there is one "right" approach to quality, and that all others can be rejected; still less has it tried to identify that one right approach. Quality is an extremely difficult concept and it is doubtful whether anyone can understand it in its full complexity. The hedonic, behavioural and behaviourist approaches, for instance, each light up a different facet. The real-world economics approach which is problem-orientated rather than technique-orientated will use whichever technique seems appropriate for the problem at hand, or apply a mixture if necessary.

How far do criticisms that are made of Lancaster in this refutation apply to other theories? The general criticism that boundary assumptions restrict the application of any theory and that <u>ad hoc</u> assumptions can mean that the theory may have no practical application, applies to a greater or lesser extent to all theories, and its impact must be studied on a case by case basis. Some of the economic man approaches share some of Lancaster's boundary assumptions, but generally other theories do not. Most theories implicitly or explicitly assume some or all of the same fundamental assumptions on consumer preference and the supply as Lancaster. There are major differences between theories on whether to work in terms of objective characteristics, perceived attributes or beliefs, and in some theories it is never clear which are being used - it is certainly implied that it does not make much difference to the analysis. There is also an apparent difference in approach, with some people considering that the outcome of a consumption activity is a characteristic, some a service, some a utility, some even a difference between what is offered and what is supplied. To a large extent the difference is semantic, as the surrounding assumptions mean that there may be no difference, but there is scope for confusion.

INDIFFERENCE CURVES

LANCASTER'S ASSUMPTIONS

Lancaster's assumptions on the shape of the indifference curve are fundamental to his whole theory. It is a theory of consumer demand, and it is the indifference curves that show preferences and how they are translated into an individual's demand. His assumptions "simply carry over traditional preference theory, applying it to collections of characteristics instead of to collections of goods" (1971 p.20) in order "that the consumer's preferences can be expressed in the terms of an ordinal utility function of the neoclassical kind, with all its first order partial derivatives positive." (1971 p21) He assumes:

> transitivity
> completeness
> continuity
> strict convexity
> non satiation
> all characteristics positively desired.

He ends up with a simplified version of the indifference curves to be found in basic textbooks, except that the axes are labelled Characteristic A and Characteristic B instead of Good A and Good B. This is shown in Figure 5.1.

The objective of this chapter is to challenge these assumptions. It will be shown that very different indifference curves exist for many characteristics and that it will be very rare indeed that a good meets Lancaster's assumptions for all characteristics, as it must if his theory is to work.

The chapter will also identify some confusions in the fundamental logic of the theory.

AN ALTERNATIVE FORMULATION

In this section an alternative formulation of consumer preferences is presented. Like

Lancaster's it is concerned with objective characteristics (subjectivity is introduced in later chapters), and like Lancaster's it assumes that characteristics are consumed together immediately they are bought. Unlike Lancaster's preferences, this conforms with common experience, and it deals quite easily with situations which Lancaster has to assume away: it does not require that two size six shoes equal one size twelve or that everyone prefers a size twelve shoe to a size eight. The formulation presented here does however suggest that Lancaster's preference assumptions are an unusual special case, rather than being generally applicable in the real world.

CHARACTERISTICS CONSUMED TOGETHER

Traditional economics does not draw the distinction between goods being consumed together and goods being consumed separately.[20] It can deal with consumer preferences between unrelated goods like bread and petrol, because it is implicitly assumed that the goods are not consumed together but the bread is eaten and the petrol is put in a car.

When one analyses the quality of a good composed of characteristics, one must accept that most, if not all, characteristics will be consumed together. Lancaster also considers the situation where different goods are bought but they are consumed together, and again it must be accepted that most characteristics are consumed together - he assumes that they are consumed immediately they are purchased.

It will usually be the case that characteristics consumed together will be valued differently to the same characteristics consumed separately. Any theory which ignores this must be suspect.

Lancaster's assumption that everything purchased is consumed at the same time is a convenient simplifying assumption (though he does not drop it, so it may be considered a boundary or ad hoc assumption). It avoids the problems of the market basket going into the pantry and its contents being consumed over a period, in which case a single meal might be composed of characteristics bought in several shopping expeditions. If a time dimension were brought in to the analysis it would cause serious problems in aggregation and in relating preferences to purchases.

Lancaster Three, the automobile example, is not compatible with the assumption of instant consumption. The "characteristics" are consumed over time and it is possible to consume some of them separately - the comfort but not the engine power may be consumed when sitting in a traffic jam with the engine turned off.

Time could be a serious problem in applying Lancaster's theory, but since he has

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[20] Complementary goods are mentioned in the textbooks, but are often ignored in analysis.

assumed it away, all that need be done here is to mention the fact.

SATIATION

"Non satiation" is a key assumption of Lancaster One, though there is a brief examination of the possibility of satiation in Lancaster Two (1971 Chapter 9). This assumption was made in order to get an indifference curve shaped like that in Figure 5.1. In this section it will be suggested that there are many different types of satiation and that virtually all products will show some satiation on at least one characteristic.

Satiation in Total Consumption

Lancaster One's indifference curves are drawn on a plane with the characteristics z_1 and z_2 on the axes. (i.e. Level of Characteristic A and level of Characteristic B in Fig. 5.1.). Initially the definitions are such that these are in essence:

> "The amount of characteristic A in total consumption"
> "The amount of characteristic B in total consumption"

and he assumes that the characteristic A can come from any mix of any goods in total consumption containing characteristic A. His discussion of satiation relates to satiation arising from increased income. His discussion therefore relates to satiation arising when one has too much sugar in total consumption, and not to having a wine that is too sweet, or eating so many Smarties that one does not want any more Smarties, or any chocolate at all.

It is also different from the satiation that arises from having tomato sauce at every meal - which is more a matter of boredom and satiation over time than satiation due to increased income.

Even in the case of satiation due to increased income it is difficult to produce indifference curves like Lancaster's, as the following example will show. Let us start, as Lancaster One does, with a situation where the consumer is concerned only with the total level of each characteristic in his or her total consumption. Let us further assume that there are two characteristics of interest and they are quite independent: the consumer's satisfaction from one is quite independent of the level of the other. Table 5.1 shows an example of one possible outcome. Here the marginal utility first increases with level of characteristic, then stays constant, then becomes negative. Where marginal utility is increasing, the consumer is better off with all Characteristic A or all Characteristic B than with smaller quantities of both: the indifference curve is concave to the origin. As the level of the characteristics

increases, the indifference curve briefly becomes something like a straight line. It then becomes a circle around the highest level of utility, where both characteristic A and characteristic B produce the highest level of utility. This looks like the bull's eye of a target, with concentric circles for mixes giving lower utility.

In order to get curves that to some extent resemble Lancaster's it is necessary to assume positive but declining marginal utility (Table 5.2) and to get the textbook figures zero marginal utility must be assumed for most of the curve. (Table 5.3).

TABLE 5.1

UTILITY OBTAINED FROM TWO INDEPENDENTLY VALUED CHARACTERISTICS

Char A	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	18	19	20	23	27	31	35	39	43	47	51	54	57	57	57	56	54	51	47	42	36
19	24	25	26	29	33	37	41	45	49	53	57	60	63	63	63	62	60	57	53	48	42
18	29	30	31	34	38	42	46	50	54	58	62	65	68	68	68	67	65	62	58	53	47
17	33	34	35	38	42	46	50	54	58	62	66	69	72	72	72	71	69	66	62	57	51
16	36	37	38	41	45	49	53	57	61	65	69	72	75	75	75	74	72	69	65	60	54
15	38	39	40	43	47	51	55	59	63	67	71	74	77	77	77	76	74	71	67	62	56
14	39	40	41	44	48	52	56	60	64	68	72	75	78	78	78	77	75	72	68	63	57
13	39	40	41	44	48	52	56	60	64	68	72	75	78	78	78	77	75	72	68	63	57
12	39	40	41	44	48	52	56	60	64	68	72	75	78	78	78	77	75	72	68	63	57
11	38	39	40	43	47	51	55	59	63	67	71	74	77	77	77	76	74	71	67	62	56
10	36	37	38	41	45	49	53	57	61	65	69	72	75	75	75	74	72	69	65	60	54
9	33	34	35	38	42	46	50	54	58	62	66	69	72	72	72	71	69	66	62	57	51
8	29	30	31	34	38	42	46	50	54	58	62	65	68	68	68	67	65	62	58	53	47
7	25	26	27	30	34	38	42	46	50	54	58	61	64	64	64	63	61	58	54	49	43
6	21	22	23	26	30	34	38	42	46	50	54	57	60	60	60	59	57	54	50	45	39
5	17	18	19	22	26	30	34	38	42	46	50	53	56	56	56	55	53	50	46	41	35
4	9	10	11	14	18	22	26	30	34	38	42	45	48	48	48	47	45	42	38	33	27
3	5	6	7	10	14	18	22	26	30	34	38	41	44	44	44	43	41	38	34	29	23
2	2	3	4	7	11	15	19	23	27	31	35	38	41	41	41	40	38	35	31	26	20
1	1	2	3	6	10	14	18	22	26	30	34	37	40	40	40	39	37	34	30	25	19
0		1	2	5	9	13	17	21	25	29	33	36	39	39	39	38	36	33	29	24	18

Char A   Level of Characteristic B

Note: For each axis there is an increasing, then a declining average utility.
Marginal utility increases then falls until it is negative.

TABLE 5.2

UTILITY OBTAINED FROM TWO INDEPENDENTLY VALUED CHARACTERISTICS

Char A \ B	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	210	230	249	267	284	300	315	329	342	354	365	375	384	392	399	405	410	414	417	419	420
19	209	229	248	266	283	299	314	328	341	353	364	374	383	391	398	404	409	413	416	418	419
18	207	227	246	264	281	297	312	326	339	351	362	372	381	389	396	402	407	411	414	416	417
17	204	224	243	261	278	294	309	323	336	348	359	369	378	386	393	399	404	408	411	413	414
16	200	220	239	257	274	290	305	319	332	344	355	365	374	382	389	395	400	404	407	409	410
15	195	215	234	252	269	285	300	314	327	339	350	360	369	377	384	390	395	399	402	404	405
14	189	209	228	246	263	279	294	308	321	333	344	354	363	371	378	384	389	393	396	398	399
13	182	202	221	239	256	272	287	301	314	326	337	347	356	364	371	377	382	386	389	391	392
12	174	194	213	231	248	264	279	293	306	318	329	339	348	356	363	369	374	378	381	383	384
11	165	185	204	222	239	255	270	284	297	309	320	330	339	347	354	360	365	369	372	374	375
10	155	175	194	212	229	245	260	274	287	299	310	320	329	337	344	350	355	359	362	364	365
9	144	164	183	201	218	234	249	263	276	288	299	309	318	326	333	339	344	348	351	353	354
8	132	152	171	189	206	222	237	251	264	276	287	297	306	314	321	327	332	336	339	341	342
7	119	139	158	176	193	209	224	238	251	263	274	284	293	301	308	314	319	323	326	328	329
6	105	125	144	162	179	195	210	224	237	249	260	270	279	287	294	300	305	309	312	314	315
5	90	110	129	147	164	180	195	209	222	234	245	255	264	272	279	285	290	294	297	299	300
4	74	94	113	131	148	164	179	193	206	218	229	239	248	256	263	269	274	278	281	283	284
3	57	77	96	114	131	147	162	176	189	201	212	222	231	239	246	252	257	261	264	266	267
2	39	59	78	96	113	129	144	158	171	183	194	204	213	221	228	234	239	243	246	248	249
1	20	40	59	77	94	110	125	139	152	164	175	185	194	202	209	215	220	224	227	229	230
0		20	39	57	74	90	105	119	132	144	155	165	174	182	189	195	200	204	207	209	210

Char A   **Level of Characteristic B**

Note:A positive, but declining marginal utility is assumed for both A and B.

TABLE 5.3

UTILITY OBTAINED FROM TWO INDEPENDENTLY VALUED CHARACTERISTICS

Char A	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	1…
20	168	188	207	225	242	258	273	278	283	285	285	286	286	286	286	286	286	286	286	28
19	168	188	207	225	242	258	273	278	283	285	285	286	286	286	286	286	286	286	286	28
18	168	188	207	225	242	258	273	278	283	285	285	286	286	286	286	286	286	286	286	28
17	168	188	207	225	242	258	273	278	283	285	285	286	286	286	286	286	286	286	286	28
16	167	187	206	224	241	257	272	277	282	284	284	285	285	285	285	285	285	285	285	28
15	167	187	206	224	241	257	272	277	282	284	284	285	285	285	285	285	285	285	285	28
14	167	187	206	224	241	257	272	277	282	284	284	285	285	285	285	285	285	285	285	28
13	166	186	205	223	240	256	271	276	281	283	283	284	284	284	284	284	284	284	284	28
12	166	186	205	223	240	256	271	276	281	283	283	284	284	284	284	284	284	284	284	28
11	165	185	204	222	239	255	270	275	280	282	282	283	283	283	283	283	283	283	283	28
10	155	175	194	212	229	245	260	265	270	272	272	273	273	273	273	273	273	273	273	27
9	144	164	183	201	218	234	249	254	259	261	261	262	262	262	262	262	262	262	262	26
8	132	152	171	189	206	222	237	242	247	249	249	250	250	250	250	250	250	250	250	25
7	119	139	158	176	193	209	224	229	234	236	236	237	237	237	237	237	237	237	237	23
6	105	125	144	162	179	195	210	215	220	222	222	223	223	223	223	223	223	223	223	22
5	90	110	129	147	164	180	195	200	205	207	207	208	208	208	208	208	208	208	208	20
4	74	94	113	131	148	164	179	184	189	191	191	192	192	192	192	192	192	192	192	19
3	57	77	96	114	131	147	162	167	172	174	174	175	175	175	175	175	175	175	175	17
2	39	59	78	96	113	129	144	149	154	156	156	157	157	157	157	157	157	157	157	15
1	20	40	59	77	94	110	125	130	135	137	137	138	138	138	138	138	138	138	138	13
0		20	39	57	74	90	105	110	115	117	117	118	118	118	118	118	118	118	118	11

Char A — **Level of Characteristic B**

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Note: Zero marginal utility is assumed for most of the curve
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However, there is no reason to believe that the only relevant area will be where there is declining marginal utility or zero marginal utility. In fact, since the characteristics of a good come together in a bundle, it seems likely that for any good some characteristics will be at the increasing marginal utility stage and some at the negative marginal utility stage even if the "main" characteristic is at the declining marginal utility stage. Furthermore, it cannot be expected that all consumers will agree as to the levels of utility.

This shows that even if the characteristics are independently valued, once one accepts the possibility of satiation with increased income, or increasing marginal utility, the indifference curves do not correspond to those assumed by Lancaster.

Satiation from a single product line

A consumer gets a different sort of satiation from consuming more of a single product line, a third helping of turkey, a fifth Mars bar. There are two distinct forms of satiation. One is related to the product line: "Not another Mars Bar, can't I have a Wispa instead?" or to a larger group "Not another chocolate bar, can't I have an ice lolly instead?". This implies that in some way the Mars Bar is a single experience rather than separate experience of each of a bundle of characteristics. This is quite impossible under Lancaster's assumptions. A second form is "I would love to eat more turkey, but I am full" implying that there is satiation in one characteristic only, bulk. Similarly "I would love another glass of wine, but I have to drive home" suggests satiation in one characteristic, alcohol. In these the satiation is from one characteristic, but affects a wider range, all bulky food or all alcoholic drinks.

Satiation of one characteristic in a good

Satiation may occur when one characteristic in a good is increased, with the others remaining constant (which is equivalent to purchasing another good with a different characteristics mix).

An example would be increasing the amount of chilli in a curry to make it hotter. A curry with lots of spice but no chilli might be improved by making it hotter, to improve its balance. After the optimum blend, though, more chilli would produce a progressively worse balance of spices. This satiation is a matter of the consumer's perception of that curry. Far more chilli would have to be applied before one could say that there was too much chilli in a meal or in one's diet as a whole, and more still before one could say that there was too much chilli in total consumption (and this begs the question of whether people do have a concept of "Level of chilli in total consumption"). None of these types of satiation except chilli in total consumption fit in with Lancaster's model.

Satiation with combinable goods

Lancaster has assumed that any goods can be combined and their characteristics consumed together. For example a coffee with high aroma and little body can be blended with a coffee with more body, to make more acceptable mix. Any one of the component coffees may have such a high level of one characteristic that it is unpleasant, while the blend is pleasant. With such blends satiation can still occur, but it is not reached so easily: the strength of a pure robusta coffee may become unpleasant after a cup or two, while one can drink four or five cups of the blend. This is an example of manufacturing, not household production. This is not a decision relating to coffee in total consumption, as in Lancaster's theory.

Non combinable goods

With non-combinable goods the position is different. It could be argued, for example, that a box of Black Magic chocolates will give less satiation than a box of chocolates all of which are identical, with the same average level of characteristic as the assortment. (Again we are not talking of an instant in time, but of the half hour it would take a chocoholic to consume a box).

Concentrated Goods

Some goods are more concentrated, in the sense that they have less of the neutral, "filler" characteristics which people do not want, and more of each of the relevant characteristics, but the proportion of these remains the same. Examples are fruit juice concentrate, dried mashed potatoes or whisky (which happen to be products where removing "irrelevant" characteristics results in transport savings). For a product that is the sum of its ingredients, a more concentrated product usually implies that a "filler" has been excluded, a low value characteristic that has relatively little impact on acceptability, or is easily replaced at the time of final consumption. However, the fact that the removal of a characteristic changes the palatability of some goods suggests that the characteristic is not in fact irrelevant, and there is a significant change in product.

For some products, removing the filler means that satiation through bulk takes longer, implying that bulk is the characteristic that causes satiation (e.g. bran in maize flour). Sometimes indeed the characteristics removed are harmful or undesirable, but that implies that a different good has been created.

There are some characteristics that can be increased without changing the level of other characteristics, but it is difficult to think of a product where this is so for all characteristics of a good.

For these reasons it is safer to think of concentrated goods as different goods, with a different characteristics mix. Lancaster, however, considers that one unit of concentrated product is identical to two units of a product with half the concentration of the same characteristics. He argues

> "A characteristic is totally irrelevant if it does not appear in consumers preference functions ('satisfies no wants'), either positively or negatively . . . We can often also rule out a characteristic that has a very low weight in preferences . . . relative to the weights of other characteristics. Note that, for a group, a characteristic whose content in the group goods might be described as not going far towards 'satisfying a want,' in relation to other

> goods, conforms to the earlier idea of a universal characteristic and
> so is ruled out" (1971 p146).

This suggests that he would be quite happy to drop fillers from the list of characteristics if they are neutral, but not otherwise. One bag of triple superphosphate is identical to three bags of single superphosphate when applied to the soil, but not in the store, as the filler has to be transported to the farm, at a cost.

Lancaster has used market level responses to determine which characteristics are relevant, market prices determined by aggregate supply and demand. The link between these and the preferences of a single individual is tenuous.

Satiation over time

It is common for a consumer to prefer one good at one moment in time, but to get tired of it, and to prefer another good later. A similar satiation can arise from having too much of a single characteristic overtime. This is excluded from Lancaster's theory.

Open and closed satiation

Lancaster draws the distinction between "open satiation" where the consumer has no interest in any further amount of a characteristic, and does not mind if it is increased, and closed satiation, where more of the characteristic reduces his satisfaction. This concept can be extended from his use purely in terms of income satiation to the types of satiation mentioned above.

Types of satiation and Characteristics Space

In each of the types of satiation discussed above, the customer gets satiated from increased quantities of one characteristic, but the type of satiation and its impact is very different. Confusion arises when it is not made clear in which space one is operating and the axes are not clearly defined and described.

The type of satiation Lancaster considers, too much sugar in total consumption, requires that any indifference curve must be plotted against "level of characteristic in total consumption".

The hotness of a curry on a plate is almost entirely independent of the level of chilli in total consumption. Instead it must be plotted against "Quantity of capsaicin per kilogram of curry" or, depending on the purpose to which the measure is being put "Quantity of capsaicin on the plate".

The satiation from eating five Mars Bars must be considered in goods space, when no other chocolate bars are available. When this is not the case, there may be a characteristics space referring to the characteristics of chocolate bars. A consumer may then be satiated with caramel, or with the soft texture, but not with chocolate. Lancaster's unthinking slip from one characteristics space to another, from his original, carefully defined level of characteristic in total consumption (sugar in ones the diet perhaps) to groups of infinitely divisible goods (characteristic of chocolate) to unit groups (automobiles) or to "normalized characteristics space" has been documented in Chapter Two. Some of the confusions that arise have been shown in this section, with regard to satiation. More will be described in the following sections.

THE BULL'S EYE

In the last section it was shown that when there is satiation with negative marginal utility from both characteristics, the indifference curve may encircle the point of greatest utility, even where the two characteristics are independently valued. This is a bull's eye, a target where a combination of characteristics gives the greatest satisfaction and the satisfactions fall away as the combination moves in any direction away from this.

The effect is more marked if the two characteristics are not independent, if the utility of one depends on the level of another. For example if wine has two characteristics, sweetness and acidity, a consumer may prefer a moderately sweet wine with an average amount of acid. If the wine is too acid or too bland, too sweet or not sweet enough, it will be on a lower indifference curve.[21]

Figure 5.2 shows such a bull's eye. The indifference curves are contours of a third dimension, utility, so in effect a three dimensional surface is being presented in two dimensions. The area of peak utility is shaded both for emphasis, and because buyers may be indifferent between points near the peak (over time at any rate)

It could be argued that where the two characteristics are independently valued, the points at which both have negative marginal utility could well be extreme levels which will not be experienced in practice, though no one can say to what extent this is true. It is certainly much more likely that these points will be relevant if the two characteristics are not independent, as in the case of the sweetness and acidity of a wine.

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[21] The example of sweetness and acidity in oranges or apples could be used, but it is easier to deal with quantity in a product sold in a standard unit.

Again, it might perhaps be argued that the level of satiation of a characteristic is seldom reached in total consumption, though evidence is scarce. It is far harder to argue this when talking of characteristics from a group of goods (e.g. potatoes), or from unit quantity of one good (e.g. acid in oranges).

Which space?

Such indifference curves may exist in several spaces. They may for example exist for total consumption, with say, total protein and total fat in the diet being the characteristics. Another possibility would be to draw such curves in the space with level of characteristic from this product group on the axes, where mixing of goods is permitted and goods are completely divisible. This could include the blending of coffee, for instance. Such a space is defined in Chapter 8 of Lancaster (1971). It may be argued that the many changes he has made to get here from his original formulation warrants treating it as a different type of space.

A third type of space is one where the level of characteristic in unit quantity is the axis. This would be appropriate for the quality of an automobile, or an orange or a bottle of wine.

The definition of a space in terms of "Level of characteristics per unit", "Level of characteristics per meal" etc. is similar to defining it in terms of "percentage characteristic A" "proportion characteristic A" and so on.

A more precise definition of characteristic can effectively change the characteristics space. If one switches from "sugar in total consumption" to "caramel in total consumption" one is dealing with a much smaller range of products. If one switches from "comfort in total consumption" to "automobile comfort in total consumption" one is in effect switching to a single group of goods, and even to a single unit of that group of goods. The clear definition of the axis may effectively introduce quiddity - here the concept of an automobile as an automobile, not as a collection of characteristics has been introduced.

Time

The indifference curves are for one purchase. If there is sequential purchase they will change: if one has bought a quantity of one good, this will mean that the indifference curve for the next purchase is different.

Advantages

The bull's eye avoids many of the problems of Lancaster's model. It does not

assume that two oranges with low sweetness are equivalent to one with high sweetness: it does not assume that sugar in an orange gives identical satisfaction to sugar in a hamburger. It does not assume that two size six shoes are identical to one size twelve shoe. It can be used to handle economy sized boxes in competition with ordinary boxes - with size of box as another characteristic.[22]

QUANTITY

Figure 5.2 deals with unit quality of a product. Figure 5.3 introduces another dimension, number of units, and shows a bull's eye at one, two and three units. Figure 5.4 shows an indifference surface joining these bull's eyes, where the consumer is indifferent between one unit of the best quality, two of the next best, and three of the third quality (with "best" of course being the subjective judgement of the individual consumer). Sometimes, of course, no quantity of third-rate produce can substitute for one unit of top quality.

Something similar must be done with divisible products that are in practice consumed separately even if they are in principle mixable. In principle consumers could blend different wines, whiskies or coffees to produce the mix they want, but in practice the blending is done by a manufacturer or distributor. This may be because the manufacturer can do it more cheaply, because there are physical or emotional costs - it is seen as taking too long or causing too much worry - or because it requires a large investment for instance. Again, it is necessary to construct an indifference surface for unit quantity of that good, and then put in a quantity axis. Because it is a divisible product the curves could be anywhere along the indifference curves of Figure 5.4.

Lancaster's definitions have been designed to make the "quantity of good" axis unnecessary by allowing complete mixability and assuming that all characteristics from all goods are consumed together. While these assumptions may have made his analysis easier, they have made it less applicable.

INGREDIENT PRODUCTS

This section discusses goods which are made up of ingredients in such a way that

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[22]   The impact of size of box, size of apple, etc is not simply one of increased quantity. Economy size boxes are intended to sell more of that good or brand. In Ireland apples are sold per apple and there is a much bigger premium for large apples than in England where they have been sold per pound. Because of this, orange importers in England have tried to introduce sale per pound instead of sale per unit, as a means of increasing their sales of small oranges

one can only increase the level of one characteristic by reducing the level of another. For example it may have three ingredients A,B, and C which must always be combined in such a way that A + B + C = 100%.

This is shown in Figure 5.5. This is a three dimensional diagram showing unit quantity of a product, a one litre bottle of wine for instance, and presenting ingredients as a percentage. The line joining 100% A and 100% B shows the product possibility curve when there is no C and the line joining 100% A and 100% C shows the product possibility curve when there is no B. The dotted line shows the single possibility when there is one third of each.

In Figure 5.6 the same diagram is shown, projected on only two axes, Percentage Characteristic A and Percentage Characteristic B. It is unnecessary to show C as % C = 100 - % A - % B. At the origin there is 100%C and different levels of C are diagonals moving out to the diagonal joining 100% A and 100 B. At the origin there is 100% C and where there is 100% A or B there is no C.

Indifference surfaces which do not lie within the range of the possible may be ignored for this discussion. It is enough to note that people may desire a product whose ingredients add up to more than 100%.

One possible preference might be a bull's eye around the point where A, B, and C each contribute a third of the ingredients (Figure 5.7) The circular indifference curves might, perhaps, be more likely when C is not valued at all.

There are several possibilities with such three-characteristic products:

-        The third characteristic C exists but is a "filler" and is not noticed by consumers, and is not therefore a characteristic, for some types of analysis at least. In this case Figures 5.7 and 5.2 are much the same.

-        C is perceived not as "wine ingredients" but as "wineness", the quiddity that tells consumers that this is wine, not beer. In this case it is perceived as invariant, and the analysis may proceed from Figure 5.2. This must be interpreted with caution however. In some cases the relation of a characteristic to the quiddity in one of its descriptions may be very important. The ratio of engine power to the quiddity "car" gives one set of utilities, the ratio of engine power to a given car body gives another completely - compare the utility from a 5 litre family saloon and a 5 litre Robin Reliant.

-        Characteristic C may have a positive, negative or neutral valuation, or a different valuation at each level (Lancaster assumes that they are positively valued). This does not stop them from being plotted as in Figure 5.7: it will affect the shape of the indifference curves.

When there are four ingredients, A, B, C and D, such that C and D cannot be conveniently lumped together, or both ignored, all may vary, and a three-dimensional diagram is necessary to describe the combinations.

It is tempting to the theoretician or market researcher to reformulate the problem to conform to his or her own perceptions or to make analysis easier. However, this can move the analysis into a different characteristics space from that of the consumer.

ALTERNATIVES TO THE BULL'S EYE

It is convenient to think of the bull's eye as a "standard" form of indifference curve for quality, describing a common preference. Indeed if one segment of the bull's eye is detached, on the grounds, perhaps, that it is the only segment relevant under the existing prices, one gets an indifference curve like that of Figure 5.1. In this section, however, it is shown that there are a great many indifference curves that bear no resemblance to either Figure 5.1 or Figure 5.2.

Paraffin oil and milk

In two-good indifference curve analysis it is assumed that milk and paraffin are two entirely separate goods which are consumed separately. Once one talks of quality one must be talking of a product whose characteristics must be consumed together, a mixture of paraffin and milk, which combine to make a single good. When the two characteristics are consumed together, the good is useless: the paraffin taints the milk, and makes it undrinkable, while the milk clogs the lamp. This is shown in Figure 5.8. The indifference curves consist of a series of points on the axes, with the consumer being indifferent between **X** litres of a good containing no paraffin and **Y** litres of a good containing no milk, and finding all mixes equally useless.

Figure 5.9 shows a slight change in the assumptions, with the consumer accepting very small quantities of paraffin in the milk. Here there is a trade off between larger quantities and greater purity. This diagram assumes an infinitely divisible good and mixability, as does Lancaster. The product possibility curve for each quantity is a diagonal. The indifference curves indicate lower utility as one moves from the axis.

An alternative presentation would be to consider unit quality of a good that is not mixable, a one-litre can of Brand X perhaps. This is shown in Figure 5.10. Here the product possibility curve is the line joining one litre milk with one litre paraffin. The axis could be millilitres paraffin per litre or percent paraffin. Where no mix is acceptable, the indifference curves must be a point on the axis where it meets the product possibility curve. This does not imply that the consumer is indifferent between one litre milk and one litre paraffin. The highest indifference curve on the milk axis might be IC3, while the highest curve on the paraffin curve might be IC1,

implying that the consumer would always take paraffin if buying only one unit. A quantity axis vertical to these would show the final choice (which might be, say, one litre of paraffin and two litres of milk).

Figure 5.11 shows the curves when some contamination is acceptable. Here again the lowest indifference curve on the "% milk" axis is IC3.

These curves are not just theoretical curiosities. Virtually all products would have some such curves between two characteristics, as contamination is nearly always a potential problem.   Many other characteristics are yes/no characteristics, like green/red, Cox/Golden Delicious, Wine/Beer, left foot/right foot. These would correspond to the diagrams for goods where no mix is acceptable. The difference is that with some of these examples no mix is possible, and the product possibility curve is a point on each axis.

The fact that a mixture of paraffin and milk is revolting has produced these indifference curves for unit quantity of the product. There is no reason to suppose that the curves plotted on total consumption axes (as in Lancaster One) bear any relation at all to these. The amount of paraffin fumes one inhales while waiting at an airport is tolerable, but if the same quantity was concentrated in a glass of milk it would be intolerable. The amount of fat consumed in a day may be optimal, but if it was concentrated in one course it would be intolerable. Lancaster has not allowed for this complete change in space when he switches from:

a)   Level of characteristic in total consumption,
b)   Level of characteristic in diet,
c)   Level of characteristic in a group of goods,
d)   Level of characteristic in an automobile.

His explicit assumptions relate only to the first.

Multiple Peaks

Lancaster assumes an indifference curve that is convex to the origin. It cannot have two or more peaks of utility. In reality a utility surface may well have several peaks. For example, in Britain or Ireland consumers have one preferred level of sugar and acid for dessert apples and a higher preferred level of both for cooking apples. This is shown in Figure 5.12 (which is for unit quantity of apple). Lancaster's assumptions would imply on the contrary that a Bramley apple with twice the sugar and twice the acid gave perhaps twice the satisfaction. The fact that the end use is different is irrelevant: it is quite normal that a characteristic or good should give several different satisfactions - food, for example, gives many satisfactions beyond basic nutrition. Lancaster accepts different end uses with reference to characteristics - he is concerned with the utility derived from a characteristic, not how it is derived. Much of the attractiveness of his theory lies precisely in this point. However, there

are similar examples which do not require different end uses. For example, one may like black coffee and coffee with 25% milk, but not coffee with 5% milk.

Such curves do not require eccentric consumers: some are firmly based in the laws of physics. Figure 5.14 for instance shows super-conductivity against the lead and yttrium content of a superconductor, and shows two peaks. Since utility is a function of the temperature at which superconductivity is achieved, there is a two peaked utility surface. The consumer would be indifferent between points on the 78° contour and on the main mountain and the separate peak.[23]

Another multiple peak occurs when two musical notes are played simultaneously. Some combinations are more pleasing than others, and ones that give high satisfaction are surrounded by discords.

Constraining Characteristics

Lancaster's basic paradigm conforms most closely to the least cost food problem and he presents this as an example. However, with his assumptions one cannot tackle some of the most important practical problems. For example, maize generally has about 10% protein, but only half of this protein can be digested as protein by humans, a major cause of protein malnutrition in maize eating countries. The reason is that the body's ability to use protein depends on the level of its constituent amino acids: in effect, the level that can be utilized depends on the amino acid with the lowest level, lysine in the case of maize. Increasing the level of protein, while leaving the lysine constant has no effect on the amount of digestible protein. Increasing the level of lysine while other amino acids remains constant increases the quantity of digestible protein, until the level is reached where some other amino acid takes over as the constraining characteristic. The indifference curves are then a series of vertical straight lines, with the series stopping abruptly when lysine is no longer the constraining characteristic.

Sugar and tea

Huber (1975) carried out an experiment examining individuals' preferences for strength of tea and amount of sugar in iced tea. The study asked respondents to compare samples of tea with different strengths and difference amounts of sugar: the colour, the amount of lemon, and the amount of water were held constant. Each respondent made preference judgments on pairs of cups, judging (a) similarity (b)

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[23] In his choice he might be influenced by the fact that a slight error in manufacturing might cause a sharper fall from the side peak.

preference, (c) strength of preference, (d) whether they would prefer more or less tea and (e) whether they would prefer more or less sugar. It took 3 - 4 hours to examine each respondent (it was implicitly assumed that their tastes remained constant over this period). A SYMAP contour mapping routine analysed the data, estimating the height (preference) of each point as a function of the level and trend of the surrounding points. This is shown in Figure 5.15.[24]

The indifference curves shown here bear no relation to those assumed by Lancaster. They are seldom convex to the origin. Utility does not rise with level of characteristic. The utility remains constant as the level of tea rises from 0 to 5, from hot water to moderately strong tea, as long as the level of sugar remains constant. This preference curve is for unit quantities of tea, not for sugar in total consumption.

Negative Characteristics

In Figure 5.17 the situation is shown where characteristic A (negatively valued) exactly counteracts one unit of characteristic B. The neutral indifference curve passes through the origin at 45°. Other curves show lower levels of utility.

Convex Curves

Lancaster assumes that all curves are strictly convex to the origin. However, there is a common situation where the value of a product falls off sharply with the level of impurity and that the product gives most satisfaction when it has zero characteristic A, zero characteristic B or both. If we consider a product consisting only of characteristic A or characteristic B, and take unit quantity, the product possibility curve is a straight line and indifference curves are points on this line as in Figure 5.10. However, if the product is divisible and mixable and we are talking of the surface for one group of goods as in Lancaster Two (1971 Chapter 9), the consumer is indifferent between small quantities of pure characteristic A and larger quantities of a mixture as in Figure 5.13.

Another example is where the characteristics give increasing marginal utility. More generally, there are the many examples above where the indifference curve may be convex in some parts, but concave in others.

THREE OR MORE CHARACTERISTICS

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[24]   Where there is perfect knowledge and people act on it, this preference map is equivalent to an indifference surface

In the models presented so far, only two characteristics have been presented, plus quantity. For each additional characteristic another dimension is needed. Figure 5.18 is a three-characteristic indifference surface for unit quantity. There is a bull's eye indifference curve between any two characteristics. The result is a set of indifference curves shaped like an onion. There is an optimum area in the middle, where a moderate amount of all three characteristics is obtained, and there are layers of indifference surfaces on top, each indicating a lower level of utility. Where the axes for two characteristics cut the onion, a typical bull's eye is revealed (Figure 5.19).

Such three-characteristic models are important in showing that a simple "more is better" assumption like Lancaster's is misleading. For example, the optimum relationship between tyres and braking system for a car is not constant, but will vary with size of engine.

One could construct a great variety of n-dimensional shapes by choosing combinations of the more exotic indifference surfaces discussed above, e.g. those in Figures 5.10, 5.12, 5.15 and 5.16. For the purpose of this discussion, all that is necessary is to point out that they bear no resemblance to those discussed by Lancaster.

CONCLUSION

Lancaster's set of assumptions on consumer preference and indifference curves are one of the three sets of fundamental assumptions on which the whole theory is based, and the theory must be rejected if it is rejected. He assumes a set of assumptions to "guarantee that the consumer's preferences can be expressed in terms of an ordinal utility function of the neoclassical kind with all its first-order partial derivatives positive." (Lancaster, 1971, p21) rather than trying to identify the preferences that really exist.

A major problem with Lancaster and many other theories has been a failure to appreciate that the utility produced when two characteristics are consumed together will almost always be different from that when they are consumed separately. This means that traditional indifference curve analysis cannot simply be transferred to quality analysis using either characteristics or attributes.

A second major problem arises from the failure to recognize that the shape of indifference surfaces will vary, depending on which characteristics space they are plotted in.[25]

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[25]   "He knows how many beans make five. He is no fool .... The reference is to an old catch. Everyone knows that five beans make five, and on getting the correct answer the

In this chapter an alternative approach to consumer preference is presented, which is to plot indifference curves without any arbitrary preconditions of transitivity, completeness, continuity, strict convexity, non-satiation and all products positively desired. It is shown that many types of curves are likely to exist which do not in any way conform to the preconditions laid down by Lancaster. Some, like the bull's eye, are likely to have a wide application. Others, like the curves relating to a taint or pesticide residues, apply to fewer characteristics, but will apply to at least one characteristic in nearly all real-world products.

As there are many objective characteristics which affect preferences for most products, it is unlikely in the extreme that there is any product for which there are no such indifference curves for any pair of objective characteristics. Where these indifference curves do hold it is not possible to use the optimizing criteria specified by Lancaster.

Lancaster appears to have believed that his assumptions on the shape of indifference curves for characteristics were at least as realistic as those for indifference curves between two distinct goods. In fact they are most unlikely to be realistic.

It is conceivable that for some people and some products, Lancaster's assumptions on indifference curves are valid. Unless they are reasonably common, however, it would be irrational for an economist to devote his time to building up a theory about them. In Chapter 8, a further question will be asked "If an individual's preference function does happen to conform to Lancaster's assumptions, is there any way of knowing that it does?"

The alternative theory presented here is more useful for analysing quality than Lancaster's. It is widely applicable; it ties in with everyday experience, it does not require nearly as many boundary assumptions as Lancaster's, which means it is more widely applicable, and it handles problems which Lancaster has to assume away. To be of any value, a theory of quality must be able to differentiate between preferences for milk and paraffin consumed separately and milk and paraffin consumed together. Lancaster's model does not permit such a distinction, while the alternative presented here does. Lancaster's theory also fails to deal with common quality problems. It assumes that two size six shoes are equivalent to one size twelve, that two slightly sweet oranges are equivalent to one sweet one plus one with no sweetness, and so on. The alternative presented here covers these cases without any difficulty.

The alternative has applications outside Lancaster's theory, in other economic theories and in marketing.

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questioner says "But you don't know how many blue beans make five white ones". The correct answer to this is "Five - if peeled". (Brewer 1992, pp.82-3).

PRICE ASSUMPTIONS

In the last chapter Lancaster's assumptions on consumer preference and demand were examined. In this chapter some of the fundamental assumptions on supply will be examined. These assumptions relate first to the price of characteristics and second to the relationships between production cost and price.

In traditional theory it is reasonable to assume for most purposes that all goods are positively priced. It may also be assumed that the supply of one good or its price is not constrained by the supply or price of other goods.

Lancaster imported the assumption from traditional theory that goods were positively priced. If one wanted to get more of a characteristic one had two choices, one could spend more and buy more of the same good, or one could switch to another good with more of that characteristic. With the assumption that all characteristics are positively valued no rational consumer - and rational, perfectly informed consumers are assumed - would ever buy a product unless it was on the efficiency frontier. If two products were identical in characteristics mix, except that one had less of characteristic A, and their prices were the same, nobody would buy any of the product with less of characteristic A. Either its price would fall, or it would be withdrawn from the market. When the market is in equilibrium, any products with less of characteristic A will be cheaper. This is argued by Lancaster from the second paradigm case, but is also a powerful implicit assumption running through his analysis.

In this chapter it will be shown that it is not a general rule that characteristics are positively priced at equilibrium in the real world. It will also be shown that one cannot argue from first principles, from production costs for instance, that it should be so. In any case where characteristics are negatively priced, Lancaster's theory cannot be applied, and the fact that negative pricing is not unusual seriously limits the application of his theory.

For the rest of this chapter Lancaster's other basic assumptions will be assumed to hold: on perfect knowledge (Assumption 2.7) on consumers all facing the same market conditions (Assumption 2.2.2), on all consumers seeing the same characteristics (Assumption 1.1), on all goods being quantitative and objectively measurable (Assumption 2.1), that all characteristics are quantitative and objectively measurable (Assumption 2.1: 1971 p15), that x times as much of the good contains x times as much of each characteristic (Assumption 2.2: 1971 p15) and that the characteristics from different goods may be added (Assumption 2.3: 1971 p15).

SOME EXCEPTIONS

In this section some situations in which Lancaster's implicit assumption of positive characteristics prices does not hold will be identified.

THE BULL'S EYE

In the last chapter it was shown that a bull's eye was a common shape for an indifference curve. If we are talking of a hock for instance, a consumer may like a moderately sweet, moderately acid wine, but find that a wine that is too sweet or too dry is less acceptable. The result is an indifference curve like that shown in Figure 5.2 or 5.7 in the last chapter. If all consumers have bull's eye indifference curves with the majority liking a moderately sweet, moderately acid wine, then the aggregate demand will also be a bull's eye. This is shown in Figure 6.1. Here the axes are the sweetness and acidity of a bottle of wine. The contours could indicate the quantity that would be bought of all bottles were the same price.

The prices that result depend on how this demand meets supply. Three scenarios based on very simple market structures with different outcomes may be considered, out of many possibilities.

1.   Acidity and sweetness are determined primarily by soil and climate, and there is not a lot the producer can do to change it. As a result, the supply of all qualities is the same. Since demand is concentrated at the centre of the bull's eye, prices will be highest there, and so price curves will fall away from the centre, as demand does.

2.   Most of the wine produced is of one type, because of soil and climate, so supply is highest at the centre of the bull's eye and falls away gradually from there. Consumer's preferences are scattered, with some preferring sweet, some dry, but aggregate demand is concentrated around the point at which there is most supply. Where there is most supply, there is most demand; where there is least supply, there is least demand. Prices are the same for all qualities.

3.   There are economies of scale in production or distribution. Most producers aim at the most popular qualities, and can supply them cheaply. It is significantly more expensive to identify and supply people with minority tastes (they may be supplied through health food shops rather than supermarkets for instance). The result is a price surface shaped like a bull's eye, but with the lowest prices in the middle.

This shows that in several possible cases the prices bear no relation to those assumed by Lancaster. In none of the three very different scenarios can one say that a more acid wine costs more than a less acid wine, a sweet than a dry wine - or vice versa.

Optimizing Purchases

It was shown in the last chapter that it is most unlikely that a consumer would have indifference curves like those assumed by Lancaster between each and every pair of characteristics. Of the many other possibilities, the bull's eye or an approximation to it may be common. It has been shown in the present chapter that prices may under some circumstances form a similar bull's eye.

How does a consumer choose the optimum purchase when his or her indifference surfaces form a bull's eye and the price of the characteristics form a bull's eye? This is shown in Figure 6.2. The curves CO_1, CO_2, CO_3, CO_4 are constant outlay curves, or iso-price curves. They join combinations that can be obtained with a given sum of money, with CO_1 being more expensive. The indifference curves show that this consumer prefers a slightly sweeter, more acid wine than most people. He or she is equally happy with an expensive wine on CO_1 and a cheap wine on CO_4, so he or she will buy the cheap one, which is very acid and sweet. At the point of purchase the indifference curve and the iso-price curve are concave to the origin. If, instead of this scenario, the figure had represented the one where the wines at the centre were cheaper, the point of purchase would be one where the indifference curve but not the iso-price curve is convex to the origin.

With another consumer, one who prefers a drier, less acid wine perhaps, the optima are at quite different points.

This bears no relation to Lancaster's optimizing procedures. His concept of a possibility frontier or an efficiency frontier is quite inappropriate here. With a single purchase and the prices quoted, the possibility function is the part of CO_4 that is concave to the origin: it is the maximum amount of sugar and acid that can be bought for any sum of money. For most people though, it is not an acceptable purchase. If another decision is made, how much wine to buy with a given budget, when wine can be bought in very small quantities, (and it is possible to buy a little of a good wine or more of an inferior wine), the decision must be plotted differently, probably with a similar figure with quantity on a third axis. This is the space appropriate to the automobile example of Lancaster Two. The model in the first part of Lancaster Two requires a totally different space with the axes "Total acid in wine consumed" and "Total sugar in wine consumed". The possibility frontier is then one where large quantities of cheap wine are bought. Since very few people drink the largest quantity of the cheapest wine they can afford, the possibility frontier, and any efficiency frontier derived from it, are irrelevant.

OTHER EXAMPLES

There are many other examples of products in which some key characteristics are not positively priced at all levels. Pure chemicals cost more than impure; black coffee costs the same as white, red cars cost the same as black, some cafes charge for the first cup of coffee but not for refills.

The various indifference curves discussed in the last chapter all affect aggregate demand, and this, in conjunction with supply, determines price. Because pure chemicals are in greater demand and because they cost more to produce, they are more expensive. Because there is no demand for milk with dung floating in it, it fetches a very low price, but this is nothing to do with the cost of producing it. Applying the range of indifference curves to different supply scenarios will give a range of different price surfaces, many of which imply negative prices for characteristics at some levels.

WHAT IS THE PRICE OF A CHARACTERISTIC?

Lancaster's theory appears to be based on individual consumers knowing the price of each characteristic at the margin. This is in accordance with the assumptions that choices are made on characteristics, that the good is seen purely as a bundle of characteristics, that the characteristics of different goods may be added, that there is perfect knowledge of characteristics (including price) and that all consumers face the same price. An alternative way to his of looking at it would be to say that the consumer may have no concept of the price of a single characteristic. He or she appraises a good as a single product, influenced by its characteristics of course, rather than appraising it purely as a bundle of characteristics. This appraisal suggests that Good L gives more utility than Good M and it is then a question of whether the difference in price is greater than the difference in utility. There is then no need to price individual characteristics. In this section it will be argued that it is unlikely that consumers know the price of a characteristic in many cases.

It is easy to conceive of the price of a good, but it is not so clear what the price of a characteristic is. In a few cases the characteristic can easily be increased by adding another ingredient or bolting an extra component, an air conditioner perhaps, to a car, so it is easy to see how much an increase costs. (These are discussed later in this chapter). Generally, though the concept is difficult for an economist and out of the range of most consumers.

For the Lancaster model we are concerned only with the prices faced by the consumer at the moment of purchase. He has decided not to allow for the

complications arising from habitual purchase patterns, those considered in search and information theory. Under perfect information, which Lancaster has assumed, the consumer has, in effect, a price list showing the prices and characteristics contents of all products in the market.

There are two distinct concepts, the price of the characteristic in the good, and the price of the characteristic to the buyer. With Lancaster's assumption of additivity it is possible to get an increased level of characteristic A, all other characteristics being the same, either by buying another good containing more A, or by changing the proportion of the different goods added to provide the combination consumed.

If there are prices for all possible characteristics mixes, the price of an extra unit of a characteristic is easily worked out: Subtract the cost of a good with a given characteristic mix from the cost of a good with identical characteristics except that it has one more unit of Characteristic A (It will be shown below that this is not always possible, notably with ingredient products, where increasing characteristic A necessarily means a smaller quantity of other ingredients)

However, markets do not have all possible combinations of characteristic on offer, as this would imply an infinite number of different goods. Furthermore, markets cannot, in practice, handle a very large number of qualities. Where the production system produces a wide range of qualities, as in agriculture, it is normal to reduce the number, by grading (i.e. sorting, classification, labelling, or pricing or some combination of these). Sub-markets may also develop, each concentrating on a limited range of qualities.

How then does one calculate the cost of a characteristic when there are, say, ten goods available each offering a very different combination of two characteristics? How does one calculate the cost of a characteristic when each of these ten goods has a different level of a third characteristic? The traditional method described by economists from Waugh onwards, has been to run a multiple regression on market level data to get "hedonic prices". Some problems that arise with this will be discussed in the next sub-section.

With Lancaster models, where the buyer, in effect, mixes his own chicken feed, there is more scope for achieving a given mix, than when the mix must be obtained by the purchase of a single good, both by adding different goods, and by increasing the quantity by linear expansion. It is then possible to calculate the least-cost way of producing one characteristic mix with the least-cost way of producing a mix that is identical except that it produces more of characteristic A, provided it is possible to mix both from the goods available. This produces an objective measure of the cost of characteristic A for that decision. It is not necessarily the same price as for another decision, increasing characteristic A from another characteristic mix. Within this context a positive price of characteristics is implicit in Lancaster.

With the more usual situation where a buyer buys a single good, and adding is not

possible, or if possible, is eccentric, (blending ones own coffee for instance) the buyer does not get any characteristic mix except that of the goods on offer.

The limited number of goods means that few people will be able to buy exactly what they would like to, given their indifference surfaces and the price list. They will have to compromise, taking more or less of one or more characteristics.

The consumer who decides to buy a product with more of Characteristic A, for instance, may end up with more of Characteristic B and less of Characteristic C, because that is the characteristics mix of the closest substitute with more of Characteristic A. This good, say, costs £x more and has y units more of A, so in one sense the cost is £x/y per unit of A.

The question then arises what is the point of calculating the marginal cost of a characteristic to the consumer: the price list already gives the information required?

It appears from this that the link between choice at the level of Lancaster's individual consumer and the implicit prices of hedonic theory produced by regressions is tenuous. In most situations it is not feasible to calculate the marginal cost to the consumer of increasing the level of each characteristic in his purchase.

REGRESSIONS AND HEDONIC ANALYSIS

In this sub-section the use of regression techniques to derive hedonic prices for the analysis of consumer decisions such as those analysed by Lancaster is discussed. The discussion is confined to consumer decision making, and it is not suggested that the weaknesses identified apply to other uses of hedonic analysis.

The options facing a buyer at the point of purchase may be described as a price list, which lists the different characteristics mixes available and their prices. Lancaster assumes that everyone faces the same market situation, but otherwise large buyers and good negotiators might face different price lists from those faced by the average buyer.   Hedonic price analysis tries to describe this price list by a multiple regression, with price dependent on the level of the characteristics.

> "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).

With some products, like cars, it may be possible to get a complete list of the prices

of all models in the market (though the difficulties of doing this when there are many variants and when discounts are given, should not be minimized). This price list may represent the list of prices facing the buyer at a given moment. For agricultural products there is normally a constantly changing price, particularly in retail markets, commodity markets, wholesale markets and auction markets. The option facing a consumer is the price at the moment of purchase, not some daily, weekly, or monthly average. Accordingly the raw data must refer to that moment in time. Because of the difficulties in collecting price data, some sort of sample is usually available rather than a complete listing. Transactions are usually recorded rather than a price list and since not all qualities are traded at any one time, only an incomplete listing is given. This may cause a bias.

A further bias arises. The price list gives equal weight to each option open to a customer. The regression does not. It gives most weight to the prices at which there are most observations. Regressions based on actual transactions will concentrate on prices and qualities at which there are many transactions, and give zero weight to prices at which there are no transactions, even if these are options open to the marginal buyer. The risk of this happening is greater if the regressions are based on sample data.

A third major bias occurs because regression assumes independence in the variables.

An example of how these three biases can affect results is as follows:
Figure 6.1 shows a situation where prices form a bull's eye. What are the results if a linear regression is fitted to this, assuming the highest prices are in the middle?

1)   If a regression is run on the whole price list, covering all possible qualities and prices with equal weighting, it will show no correlation between price and level of characteristic - the low-price:low-characteristic quotes will cancel the low-price:high-characteristic quotes.

2)   If the regression is run only on transactions at the moment in time when the consumer was in the market it will not cover all the quoted prices in the price list, but only a subset of them. Different subsets may appear dominant at different moments through the market period.

        a)   If observations are scattered randomly over the surface, there will be a poor fit, and the conclusion will be drawn that the price is not related to the level of either characteristic.

        b)   If most observations are in the bottom left quadrant, the price of both characteristics will appear to be positive.

c)   If most observations are in the top right quadrant, the price of both characteristics will appear to be negative.

d)   If most observations are in the top left quadrant, the price for Characteristic A will appear to be negative and that for Characteristic B will appear to be positive.

e)   If most observations are in the bottom right-hand quadrant the price for Characteristic A will appear to be positive and the price for Characteristic B will appear to be negative.

If results (c), (d) or (e) are achieved, the researchers may redefine the characteristics (e.g. talk of dryness of the wine rather than sweetness, neutrality rather than acidity) to get both characteristics positive, as Lancaster advises.

This shows, first, that a very different result may be obtained running a regression on a price list and running a regression on observed prices and, second, that linear regressions may give a good fit even when the price list is nothing like linear.

The bull's eye price distribution can exist where the two characteristics are priced independently, by analogy with Table 5.1 in the last chapter. It is far more likely, though, that the two characteristics are valued together, so a bull's eye can exist even where there is no satiation for the separate characteristics. In fact it seems likely that there is such a dependence between a considerable number of pairs of characteristic for any product. This casts doubt on the use of a regression procedure which assumes independence.

A regression is also an attempt to describe a distribution as a single curve. When the distribution is a price list or a surface such as Figure 6.2, that curve is a gross over-simplification. The regression also gives great weight to the areas of the surface where there are many observations, little weight to areas where there are few observations and none to areas where there are no observations during that price period. It does not, therefore, give all the options open to a consumer, as a price list does. It is particularly deceptive in that it hides the "unusual" results, which are common in a market which is not in equilibrium and which are likely to offer the best and worst bargains to a consumer - a consumer is not interested in the quantity available, as long as it is sufficient for his or her own use.

The conclusion here is that the prices of the characteristics as described by a regression may be significantly different from the options available to a marginal consumer. This means that caution is needed in calculating hedonic prices and in making use of them outside their proper area of application. They may not be the consumer prices appropriate for Lancaster's theory.

TIME PERIODS

There are of course other prices that might be reported, such as the closing prices, the mean price (weighted by volume or number of transactions), the most common price and so on.[26] There are significant practical and conceptual problems in recording these prices but these will be ignored here.

Inevitably prices must be recorded over a considerable time period to get enough observations for an econometric analysis, particularly one distinguishing between characteristics prices on different days of the week, in glut and scarcity periods, and so on.

Clearly mean prices, most common prices, and prices reported to price reporters are not the price list faced by the marginal buyer. Similarly results showing the different price structure on Mondays and Fridays do not reflect the marginal price facing buyers. This is not to suggest that such information is meaningless: it does give producers some indication of the best days of the week to sell and the qualities that may be expected to fetch higher prices. However, there is no direct link with the individual buyer of Lancaster's model.

COST OF PRODUCTION

In Lancaster One and Lancaster Two there is no suggestion that the price of characteristics is determined by the cost of production. The theory of consumer demand is not affected by whether it is or it is not. Market level effects of demand on price are ignored. In Lancaster Four, however, assumptions are made about the cost of production, in order to produce the supply side of his model. In this section it will be shown that in many cases, particularly in agriculture, the cost of supplying a particular good (i.e. a particular characteristics mix) does not determine the relative prices of options at the moment of purchase. In many of the cases where prices are set on the basis of costs, Lancaster's other assumptions do not apply, particularly those on perfect information and consumers choosing on the basis of objective characteristics. Finally it will be suggested that there are few products for which his assumptions apply.

Lancaster's assumptions are:

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[26] Rosen (1974) appears to assume that the set of prices facing the buyers is <u>at the same time</u>
-       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.

Assumption 1.3	Economies of scale in production of a single specification.
Assumption 1.4	Economies of scale specific to one variant and no joint economies.
Assumption 1.5	All economies made use of:
Assumption 2.5	All goods in a group are produced by similar technologies. Each producer of any product in the group is capable of producing any good in that group.
Assumption 2.9	It is assumed that product differentiation is potentially continuous over the group.
Assumption 2.10	It is implicitly assumed that it costs more to produce a product with more of one characteristic.

PRICES WHERE SELLERS ARE PRICE TAKERS

This section examines the prices of characteristics in markets where producers are price takers, as is usually the case in agriculture. Producers send their produce to market and accept the going market price: they are not in a position to set a price and produce only what they can sell at that price. It will be shown first that even if "generally speaking", characteristics are positively priced, they need not be positively priced to the marginal buyer, and second that the relationship between the marginal price of a characteristic facing the individual buyer and the cost of producing that characteristic is remote.

SNAPSHOT PRICES

Lancaster's individual consumer makes consumption decisions on the prices facing him. In Lancaster One and Two these are taken as given, by assumption. No account is taken of the effect that aggregate demand has on the prices.

In effect the buyer is given a price list stating the prices available at that moment in time. (Lancaster does not consider habitual purchase patterns or the complications of search theory and information economics). The only price that is relevant is the price at the moment in time when the decision is made. Long term average prices, equilibrium prices and market clearing prices are only relevant if they are the prices facing the buyer at that instant. This is not to say that they are irrelevant or inappropriate for a great many other economic decisions, just for Lancaster's

analysis.

Let us assume a market which is competitive and in which there is market clearing every day. A retail street market approximates to this, as do wholesale markets for vegetables, livestock markets, and, less directly, commodity markets and share markets. The market for perishable flowers, fruit and vegetables, for example, has prices that fluctuate wildly over a single day, and more over a week. The price for a product line may double or halve over a day's trading. This happens, for example, when the initial price for a product is set too high to clear the market during the day; later in the day it becomes clear that prices must be cut if the remaining product is to be cleared that day - and because it is perishable, anything not sold must be dumped. The price at any one time is influenced by the seller's beliefs about whether or not the price will clear stock. Beliefs will change if stocks change faster or slower than expected, if more or less is delivered than expected, if customers arrive faster or slower than expected, or if there are rumours. Buyer's expectations also influence prices, but only the expectations of those buyers who can postpone their purchases.

These fluctuations occur for groups of goods like carrots, but are larger for specific qualities of carrots. The price of one small part of the group, like Class Extra finger carrots, is very sensitive to beliefs about the amount delivered and the number of potential buyers yet to visit the market. There may be limited cross elasticity of demand between goods in the same group. For example it was found that some retailers in Dublin sell only poor Class III tomatoes: their customers reject Class I, whatever the price, as being "too good for the likes of us." When the supply of this Class III is limited and there is plenty of Class I, there is little or no premium. These fluctuations in price mean that there is a constantly changing fluctuation in the price of characteristics and in the premium for "quality" - the extra price paid for one quality defined on a mix of characteristics compared with another quality.

BUT WHAT IS THE PRICE OF A CHARACTERISTIC?

At the same time the relationship between the prices of substitutes like cabbage and brussels sprouts, or roses and lilies, changes, implying a zero or negative price of characteristics from time to time. For example, if a kilo of brussels sprouts is cheaper than a kilo of cabbage at one time and more expensive at another, the characteristic "smallness" (which may be taken to encompass all the differences) is negatively priced at the margin in one case, positively in the other. Where multiple characteristics are involved, as with lilies and roses, it is not easy to determine which characteristics become negatively valued and at which prices.

There are similar fluctuations in prices over a week, a month, a season and from year to year.

The marginal prices facing the individual buyer are determined largely by the

markets' beliefs about the current stocks and changes in supply and demand before the end of the market clearing period. How does this relate to the cost of producing the product?

In price taking markets it has been assumed that suppliers produce the good and put it on the market, then wait to see what price they get. In agricultural markets in particular, production decisions are made months or years before the product is marketed: Bramleys are being produced on trees planted a century ago. The quantity of a crop produced is largely determined at planting time. The date of planting determines the harvest date within a few days for some crops like peas for freezing, so there is little scope for postponing harvest to get a better price. Most fruit and vegetables have to be harvested when ripe and cannot be left unharvested until prices rise - the only question is whether prices will cover the cost of harvesting and marketing. The constraints on the producers of livestock and wheat are less extreme, but there is still no question of refusing to sell for a year or two until prices recover. All this means that there is, in practice, no action that a producer can take to ensure that costs are covered.

The producers' scope for action to recover their costs is more limited still where, as in agriculture, climatic factors, disease, and so on cause random fluctuations in supply and in the quality of product, and where there are other changes as producers respond to prices and expected prices. Producers may expect or hope that their prices will cover costs, but they cannot be sure.

In the long run there may be a tendency for prices to cover the cost of a characteristic, but this does not apply in the snapshot period.

PRICES WHERE SELLERS ARE PRICE MAKERS

In the last section a price-taking market was discussed, where producers put their output on the market and leave it to supply and demand to determine the price. In this section an extreme form of a market where the producers are price makers will be discussed. The producers state a price which is not negotiable. Demand will determine the amount actually sold. An example would be an oligopsonistic automobile market where each manufacturer sets a price for a good (i.e. a product line), a price which is absolutely fixed. The manufacturer responds to lack of sales of one product line by changing and re-launching it, rather than by cutting the price. In this case the price list facing the buyer is the same in the snapshot period, the market period and the short run.

CHARACTERISTICS OR ATTRIBUTES?

In a perfect market where consumers only value products for their component characteristics, as Lancaster assumes, price making is not easy. Any producer who charges a higher price for a product than a close competitor sells nothing. If he or she sells it at the same price, he or she gets a share of the market. If he or she cuts the price he or she can get 100% of this part of market, but competitors are likely to respond, creating a price war. This outcome is particularly likely where, as with motor cars, the possibility of buying variants of a model means that there are very close substitutes. It could also happen with the combinable products of Lancaster One, where the sole producer of one quality has no advantage: the product can be duplicated by mixing two others.

In practice this means that price making markets are often ones where there are major deviations from perfect competition and where Lancaster's assumptions that there is perfect information and that decisions are made on objective characteristics do not hold. In the motor industry, for example, there is a degree of oligopoly which restricts price cutting for long periods of time (though this does break down from time to time). Strong brands and poor consumer information on the relative strengths of competing goods make it easier for the producer to set prices. With most fast moving consumer goods consumers have an imperfect knowledge of the characteristic content and are strongly influenced by inaccurate perception, by brand image and by a range of cues including, for example, the shop in which the good is sold.

Another range of factors which make it possible to hold different prices for the same characteristics arises out of product variation (Chamberlin, 1953 p3).

The fact that many price making markets can only operate in situations where there is imperfect information and where decisions are not made on objective characteristics is a limitation to the general applicability of Lancaster's theory.

PRODUCTION COSTS

In price-making markets, unlike price-taking markets, production costs can have some direct impact on prices charged at factory gate, and, less directly, on market prices.
In this sub-section some relationships that may arise between characteristics content, price and production cost in the real world will be compared with Lancaster's assumptions. The aim will be to show:

1   That many relationships exist which are quite different from those assumed by Lancaster.

2   That the relationships that do exist do not imply that it costs more to produce a higher level of characteristic and most certainly do not imply that it costs

more to produce a higher level of attribute)

SOME RELEVANT FACTORS

When a firm sets prices based on its costs of production, the prices are determined by a range of factors like:

-           The perceived elasticity of demand facing the firm (not the market elasticity of demand). If there is a strong brand, or if there are no close substitutes, this is likely to be perceived as less elastic. The perceived possibility of a competitor responding by a change in price or quality is also relevant.

-           The firm's perceptions of its cost curves. These do not just indicate price and level of output as in basic production theory. Other factors such as different "levels of quality" (however defined), different tolerances and different uniformity may be taken into account.

-           The expected fluctuations in output. With cost-free storage, zero interest rates, zero risk, and perfect knowledge of future markets, it may pay to produce a constant level of output, holding a reserve stock. Normally, though, output will fluctuate so the production cost will fluctuate.

The elasticity of demand, the cost curves and the expected fluctuations in output will depend on what "level of quality" it is decided to produce.

It must be said that virtually nothing is known about how these decisions are made in practice. There are no economic models in the literature covering either the economics of quality in production or the optimum choice of quality to produce with a given set of production functions.[27]

Lancaster's model assumes a producer selling direct to the consumer, and so it assumes away most of marketing economics. In most markets one would expect an indirect relationship between production costs and consumer prices merely because of the operation of the marketing system. The price of a woolen sweater produced in Nepal and sold in London bears little relation to the cost of production. For many purposes it would be quite legitimate to try and fit Lancaster's model to any buyer

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[27]   The "Cost of Quality" approach is not an economic approach, but one developed by quality assurance engineers to tackle a different set of problems, mainly the problems of inefficient manufacturing processes producing faulty output. The approach has many problems (Bowbrick, 1992).

and any seller: it would not matter whether they were factory and wholesaler, or wholesaler and retailer for example. However, the costs of the wholesaler and retailer are different in kind to those of the original producer, implying different supply prices and, of course, different "characteristic prices" facing the buyer. Other differences arise: Nestle, for example, buys coffee on a market where the producer is a price taker and sells on a market where the producer is a price maker.

LANCASTER'S PRODUCTION COST

Lancaster Four's model relates to the cost of producing "a single good of given specification" (1979, p30) and refers to unit quantities of the good. The curve represents the maximum collection of the characteristics that can be achieved with a given unit of resources, and is called the "unit production differentiation curve or unit PDC" (Lancaster 1979, p31)

> "What shape can such a curve (or surface in the many characteristics case) be expected to have? In general, it can be expected to slope downward to the right, the amount of one characteristic being increased only by reducing the amount of the other. One possibility is that the curve is a straight line, in which case the implicit resource cost per unit of each characteristic is a constant. It seems more likely (and there is no guidance from theory or empirical study to help here) that the resource cost of embodying more of characteristic A relative to characteristic B, will rise, relative to the resource cost of characteristic B as the ratio of A to B increases, which gives a PDC having the same property of concavity towards the origin as in the traditional production possibility curve. This is the shape that will normally be assumed." (Lancaster 1979 p31)

Assumption
> It is assumed that the PDCs for different levels of resource will be geometrically similar.

However, it will be remembered that when the consumer is making a decision he or she is not concerned with the marginal cost to a producer of increasing output. He or she is concerned with the cost of buying one good rather than another. The price of an additional unit of characteristic A is the cost of buying a unit of a product which is identical, except that it has an additional unit of Characteristic A,

There are many ways in which the level of characteristic can be increased by the producer, for example:

1   -   increasing the level of characteristic A only;

2   -   increasing the level of characteristic A and some or all of the other characteristics at the same time;

3   -   providing more of the product, a bigger pack size for instance;

4   -   switching to a process with closer tolerances and so reducing risk, waste, repairs under guarantee and so on.

5   -   sorting a mixed product into grades or changing the specifications of the grades. This can increase the level of characteristic A in some grades, or change the probable level of characteristic A. The costs include those arising from a lower level of characteristic A in other grades;

6   -   advertising to change consumers' perceptions of the level of characteristic A.

7   -   developing a totally new product.

Each of these can be expected to imply different cost functions. Lancaster One is confined to (1) and (2) with (3) specifically ruled out.

The concepts of tolerances, variability, risk, uniformity and so on are not discussed.

INGREDIENT PRODUCTS

Lancaster One and Two best fit ingredient products, products which are manufactured by combining characteristics or by combining raw materials which are themselves combinations of characteristics (as in his diet example).

There is a class of ingredient products where the characteristics are ingredients and are mixed together to produce another product like pigfeed or a stew. Here it is not possible to increase the level of one ingredient without reducing the level of another. It is not possible to produce a tin of stew which is identical to another except that it has more carrots: the carrots must replace something else. To the producer there is no "cost of increasing the carrot content" and to the consumer there is no "price of carrots". The consumer can buy a smaller quantity of the preferred proportions, but not an identical quantity plus carrot.

If the stew was not sold by the can, but by weight, the consumer would be able to select a stew with the same properties of each ingredient but more carrot, and buy a larger quantity of it - essentially Lancaster's basic model. In this case there would

be an objective extra price to the consumer for more carrot. This does not however fit in with his concept of the PDC which is for unit quantity.

With some products purity is important. The cost of producing a contaminated product is low and the price rises as the purity rises, rising very sharply indeed as perfect purity is achieved. An example is alcohol, where it is easy to produce a mix of ethyl alcohol and the poisonous methyl alcohol, and expensive to produce a product that is 100% ethyl alcohol. This cannot be treated as a rapidly increasing cost of producing ethyl alcohol, as it is very cheap to produce more of the mix. In addition, if the alcohol is required for drinking, it is not added ethyl alcohol that is in demand: it is the absence of methyl alcohol as customers will be quite happy if it is replaced by water. For some laboratory purposes a small contamination with methyl alcohol is acceptable, but not contamination with water.

In this case, whether the product is defined as ethyl alcohol or absence of methyl alcohol, it has a positive cost at some levels and a negative cost at others. At one level it is very cheap to produce more ethyl alcohol, but very expensive to produce a higher percentage ethyl alcohol. Where the demand is not so much for more ethyl alcohol as for less methyl, it is misleading to talk of the positive price for this characteristic.

How does Lancaster's model suit this type of product? Let us take first the situation where the product is an ingredient one, made by mixing two characteristics which are ingredients and where there is no mixing cost. The only possible combinations for a unit of 1 kilogram are on a straight line joining 1 kilogram of characteristic A with 1 kilogram characteristic B. If A and B cost the same, the Product Differentiation Curve, the maximum amount of product that can be obtained for a given resource, is a straight line on the same product possibility curve. This is so for all levels of resource as long as it is at least enough to produce 1 kilogram of product. (The PDC is for unit quantity by Lancaster's definition: presumably with enough resources two units becomes possible, but this requires a quantity axis). If there are not enough resources to produce 1 kilogram, there is no PDC. If, however A and B do not cost the same, the PDC is a curve covering only part of the product possibility curve - all combinations that can be obtained with that level of resources.

With alcohol we have the position where it is cheap to produce a mixture of methyl and ethyl alcohols, and the cost rises as greater purity is achieved. Again the product possibility curve is a straight line joining one litre methyl alcohol with one litre ethyl alcohol. There is no PDC if there is insufficient resource to produce one litre. The lowest PDC is a point on the product possibility curve, the lowest resource cost at which one litre can be produced. For higher resources the PDC is a line on the product possibility curve joining the maximum amount of ethyl alcohol and the maximum amount of methyl alcohol that can be produced with this resource. Above a certain level all the product possibility curve will coincide with the PDC (though if we have a quantity axis, which Lancaster does not, it may be possible to produce two litres of the mix for the same price as one litre of the pure product).

For ingredient products, therefore, the PDC and product possibility curves are nothing like those put forward by Lancaster. This is of great concern since they are the ones that fit his assumptions best in other ways and are the basis of his diet example.

Formally, the same constraints would hold when blending whisky or coffee. Strictly speaking the chemicals that create taste and aroma are ingredients and can only be increased by reducing others. In practice though it is possible to think of flavours and aromas as being the characteristics the consumer likes and to take these as being independent of characteristics like alcohol and colouring in the whisky. Indeed, since it is the flavour that people make their decisions on, this is a characteristic in one of Lancaster's senses: "those objective properties of things that are relevant to choice by people" (Lancaster, 1971 p6). However it is difficult to fit these aromas and flavour characteristics into Lancaster's other assumptions e.g. Assumption 2.1 "all characteristics are quantitative and objectively measurable" (Lancaster 1971 p15); Assumption 2.2 Linearity Assumption 2.3 Additivity.

The wine example earlier in this chapter could be presented as an ingredient product with water, acid and sugar as the ingredients, in which case one might plot similar graphs, one for each level of water, each with a product possibility curve for levels of sugar and acid. It is possible to present it in the much more comprehensible form of the bull's eye only because it is possible to assume that the third characteristic, water, is a neutral characteristic, a filler, (which is not compatible with Lancaster, because of the basic Assumption 2.15 that all characteristics are positively desired). The bull's eye surface could also be thought of as a diagonal slice through a three dimensional surface (water, acid, sugar) to show only two characteristics.

This difficulty falls away if instead of the characteristics, "quantity of acid", and "quantity of sugar", we have the attributes "perceived sweetness" and "perceived acidity" where the level of water is somehow subsumed into the perception (wines are not described in terms of their water content). The product is then not an ingredient product and there is no requirement that the characteristics add up to 100 per cent. However this is achieved by dropping Lancaster's assumption of an objective characteristic and replacing it with subjective perception.

It is concluded that for ingredient goods, the ones which most closely match Lancaster's assumptions, and his diet example, his concept of PDC is wrongly formulated. This is in part due to a continuing confusion as to which space he is operating in.

There is no obvious reason why Lancaster's (1979) assumptions:

1.3   Economies of scale in production of a single specification;
1.4   Economies of scale specific to one variant;

2.5   Each producer can produce any good in a group.

should hold generally with ingredient goods.

COMPONENT GOODS

The other main category where it seems likely at first glance that one can easily identify the cost of characteristics is component goods. Cars or computers, for instances cannot usefully be considered to be a mix of ingredients: 75% steel, 13% silica, 6% rubber and so on. Instead they are assembled from components and the product can be described largely in terms of its components e.g.: a computer is marketed as "80486 5X, 20 MH 120/200 MB hard disk, 4 MB RAM (MAX 20 MB) High Resolution sidelit LCD screen/PCM CIA slot, 2.9 kilogram" (Personal Computer World Aug. 1993). This is the list of objective characteristics on which the consumer makes his choice, and so is consistent with Lancaster's basic assumptions.

The production cost of such a product is relatively easy to calculate. One starts with a basic chassis and design, and the cost of fitting one chip rather than another, one level of memory rather than another, is simply the difference in the cost of the components.
However these products do not fit in with Lancaster's assumptions:

> Assumption 2.9 (1971) There is no quiddity
> Assumption 1.3 (1979) Economies of scale of a single specification
> Assumption 1.4 (1979) Economies of scale specific to one variant.

There is a quiddity like "a Toshiba laptop" or "A Ford Escort" both as a basic chassis to be built on (from the producer's point of view), and as a brand or model image (from the consumer's). The economies of scale are not limited to one variant: once it is decided to build a Ford Escort, or a Toshiba laptop and to produce a certain number, the economies of scale have already been achieved: the costs of putting different engines on 20% of the cars or different memories on 5% of the computers are the added costs of the components, rather than extensive re-tooling costs. To the assembler there are few or no economies of scale in production. The fact that the chips may be made by firms like Intel who supply many manufacturers suggests that there may not even be economies of scale of this level.[28]

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[28]   "A key factor in the growth of the Japanese electronics industry after the Second World War was the division between the function of component supplier and final product assembler. . . The key component includes core technological information and is widely used in many final products. The component supplier's design policy is to maximize the cost-benefit in one product category. Although the key component system involves the risk that information about new model planning may be leaked to other manufacturers

However the fact that a car is built of components and is described largely in terms of components does not necessarily imply that consumers visualize them purely or even largely in terms of these components. Lancaster himself (Lancaster Three) used

1) accommodation (size and comfort of seating)
2) ride qualities
3) handling and steering
4) engine (quietness and performance)
5) brakes
6) frequency of repair of that model in the past
7) manufacturer's suggested price

as reported by a consumer organization (Lancaster 1971 p170). These are not the objectively measurable characteristics assumed in his theory, rather the judgement of the consumer organization's testers using the criterion of their beliefs about what a typical buyer of Consumer Reports would prefer (it may be that they would have reported differently if they had been writing for a sports car magazine).

He does not explain this, but it would suggest that he was thinking of a consumer deciding on the specifications he or she wanted, engine size and so on and then choosing the brand that was the better car within these specifications. He certainly does not cover the person whose last two cars, VWs, were satisfactory and who therefore wants to buy a VW with higher specifications.

The criteria for choice selected by Lancaster are not simply linked to the cost of objective components. "Handling and steering", for example, depend on the design and the relationship between different components. Fitting more expensive tyres or shock absorbers may not achieve the objective, particularly if they were fitted to the left hand side of the car only. Fitting a heavier, more powerful engine would give better engine performance but would upset handling and steering.

Accordingly, even if the criteria selected by Lancaster were objective, one could not expect the simple relation between quality of component and quality of characteristic. Proportion and balance would be important.

OUTPUTS DIFFERENT TO THE INPUTS

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through the component supplier because of the quantity of order or specification requests, the final product assembler enjoys low costs and quality improvement through the expansion of mass production in the component supplier. Also the key component system lowers the entry barrier for the market follower and expands the market." (Shibata, 1993, citing Itami, 1989)

With most goods the characteristics of the outputs are different in kind to those of the inputs. In agriculture the characteristics of the outputs (e.g. meat, grain, vegetables) bear no relation to those of the inputs (e.g. land, labour, fertilizer). The services provided by a house (e.g. shelter, comfort, status) do not share any characteristics with the inputs. Even with a component product like a computer, the characteristics of the product depend only partly on the components: the design of the configuration, the care and attention with which the components are assembled, the backup and guarantee, have a lot to do with whether or not the computer works and continues to work, what tasks it can tackle, and the risk faced by the purchaser. These important quality criteria cannot be described in terms of the component characteristics.

In these cases there is less intuitive reason to believe that there will be a positive relationship between cost and level of characteristics than with ingredient or component goods.

In agriculture there are many cases where the level of characteristics is not directly related to the cost of production. For example there is a strong correlation between the yield of a crop of Virginia tobacco and the price it gets, indicating a lower unit cost for the more expensive tobacco. With cauliflower the inputs and cultivation methods that produce the highest yields produce the highest quality (using one set of criteria). The inputs used for producing Jamaican Blue Mountain coffee are no different from those for ordinary arabica, though the price is ten times higher: the soil is different. Champagne uses the same inputs as any sparkling wine using the same process. The land that produces a good crop pays a high rent and the farmer and distributor may also earn a rent. For the purpose of this argument we can ignore these rents. They do not support the argument that it is the cost of producing additional units of a characteristic that puts up its price. Rather than market sets the price, and the farmers who have the right quality and location of land and the right skills earn an economic rent. With tobacco for example, the price of land in different areas rises as the market preference switches to different styles. The skill of the farmer and farm workers largely determines the level of the characteristic. To the extent that they are tied to one bit of land and a handful of possible cash crops, and that their skills are not transferrable to other industries, they cannot reduce the level of one characteristic in their product by switching resources to another crop or industry.

In industry, too, a good management team can improve quality - using quality to mean closer conformance to specifications in the quality assurance sense, rather than in Lancaster's sense of a higher level of characteristic. It is strongly argued by Juran (1979) for instance that "Quality is free"; that improved conformance to specifications cuts rework costs and repairs under guarantee to such an extent that unit costs actually fall. Clearly in this case costs are not forcing up prices.

Here as elsewhere the quality which the market values is likely to depend on the

balance between characteristics as much as their level.

SUMMARY

In this chapter Lancaster's fundamental assumption on the supply side, that there is a positive price for all characteristics at equilibrium, was examined. This assumption is implicit but vital to Lancaster and some other approaches to quality.

Some instances were shown where there is not in fact a positive cost for the characteristic. The bull's eye price distribution is an example. In this case the possibility frontier and efficiency frontier defined by Lancaster become irrelevant. As these are critical to consumer choice, his theory is not operational in these cases. It is probable that one at least of the characteristics of a product will be negatively priced at some level, especially if characteristics are independently valued.

If the possibility of negative characteristic prices is taken in conjunction with the indifference curves developed in the last chapter, the optimization conditions bear no relation to those produced by Lancaster.

MARKETING

It cannot be assumed that because it costs more to produce a good with more of a characteristic, the price will be higher.

Whatever the cost of producing higher levels of characteristics in the factory, the marketing system can hide the effect. This is particularly obvious in the example of putting perishable vegetables onto a market.

Generally the marketing system and market structure can obscure the relationship. A factor that arises with the analysis of quality, but not with the usual marketing economics models, is that producers, consumers and retailers have difference perceptions of quality. A retailer may be interested in speed of turnover, promptness and reliability of delivery and so on - all attributes of the product line as a whole rather than a single item. All these characteristics are invisible to the final buyer and are, therefore, excluded from Lancaster's model.

REGRESSIONS AND HEDONIC PRICES

There is often no clear meaning to the concept of the cost of a characteristic. The use of regression equations to produce hedonic prices produces results which are incorrect for the analysis of individual consumer demand. It is particularly serious

that a regression may indicate a linear or curvelinear relationship for the prices facing the marginal consumer when no such relationship exists. Accordingly, Lancaster's model cannot be used to justify hedonic approaches.

PRODUCTION COSTS

Lancaster Four makes assumptions about the cost of production influencing prices of characteristics. They can be questioned from a marketing or cost of production point of view. It is shown that in price-taking markets (like most agricultural markets) the relationship between cost of production and the cost of characteristics in alternative goods facing the marginal buyer is indirect at best. In price-making markets the possibility is there, but both in practice and in theory the relationship between production costs and price is obscure.

With ingredient goods, which are the ones that appear to fit Lancaster's assumptions best, the Unit Production Differentiation Curve bears no relation to that postulated by Lancaster.

With component goods, the other example where level of characteristic is likely to be related to cost, Lancaster's assumptions on economies of scale may not hold. Components may prove to be the factors on which consumers' decisions are made. For the class of goods where the output characteristics are not the same as the input characteristics there is no reason to assume positively priced characteristics or any of the assumptions of economies of scale.

It is concluded that there is no justification for either the assumption that it costs more to produce more of a characteristic or the assumption that if this were so it would influence the price options to the marginal consumer.

In this chapter new theory has been developed relating to the price of characteristics in demand theory, the optimizing conditions for consumer demand and the use of regression equations and hedonic prices in the analysis of consumer demand. The analysis of the relationship between cost of production of a characteristic is also new.

SUBJECTIVE OR OBJECTIVE?

Lancaster's theory assumes that individual consumers make their decisions solely on the basis of the objective physical characteristics of a product, about which there is perfect knowledge. Their beliefs, their perceptions, and their decision processes are applied, in some way that does not concern him, to a choice which can be related to objective characteristics. This assumption clearly distinguishes him from those people working in marketing and marketing economics who believe that individuals' perception of objective characteristics is inevitably wrong, and who therefore take into account advertising, information, attitudes, beliefs and strength of belief. Those other economic approaches based on individuals tend to be based on objective characteristics, and where they claim not to be (e.g. Ladd and Zober, 1979) it is not clear that the implications have been considered. Waugh (1928) used the concept of splitting the idiosyncratic beliefs and perceptions of buyers from the objective characteristics of the product at market level, but the conceptual basis is very different there.

The problems of relating individual consumers' perceptions and beliefs to market demand are familiar in marketing. One of the big attractions of Lancaster's theory is that it appears to provide an a way of avoiding these by separating subjective and the objective. It is also an attraction that he offers the possibility of a meaningful analysis which ignores the difficult task of identifying beliefs and perceptions.

Lancaster bases his theory formally on individual perception and objective characteristics because:

> "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)

Indifference curves are fundamental to Lancaster's theory, and they must be plotted against objective characteristics rather than subjective attributes for several reasons:-

1.   An individual can plot his or her own preferences only against what he or she perceives, subjective attributes. Since they are not plotted against objective characteristics, it is not possible to see how changes in objective characteristics would affect his or her choice. Only if

subjective and objective were the same would this be possible.

2.   If two consumers plot their preferences against their own subjective perception, then neither set of preferences will be plotted against objective characteristics. Since they may not have the same subjective attributes, the identical product may be plotted at two different points.

3.   If two consumers share the same concepts of the relevant attributes, "Sweetness" and "Acidity", perhaps, the perceptions can both be plotted against "Perceived level of attribute". However, the consumers may perceive the level of sweetness and acidity in any one good differently. In this case, any good will be represented as one point by one consumer, another by another. Neither would correspond to the objective level, or the level assumed by the outside researcher.

4.   If it is not possible to plot two individuals' demands against the same objective characteristics, it is not possible to aggregate the demand in the way postulated by Lancaster.

5.   If there is imperfect knowledge and perception about the level of characteristic, then individuals will have varying confidence in their beliefs. When one is buying food, for example, one may believe that the fish is fresh, but one's decision depends largely on the strength of one's belief. Lancaster's model does not cover this, though risk is a major quality element.

As with the criticisms raised in other chapters, these only have to apply to a single pair of characteristics to make the theory inapplicable in any case.

The practical problems of plotting indifference curves are considered in more detail in the next chapter. Before proceeding to these it will be necessary to expand on some of the conceptual problems arising from the assumption of perfect information.

ASSUMPTIONS

Lancaster confines his analysis to goods which are composed of objective characteristics. The assumptions he makes are as follows:

Assumption 1.1   Characteristics are those objective properties of things that are relevant to choice by people. All people agree on these objective characteristics.

Assumption 1.2   "All goods possess objective characteristics relevant to choices which people make among different collections of goods. The relationship between a given quantity of a good (or a collection of goods) and the characteristics which it possess is essentially a technical relationship, depending on the objective properties of the goods and, sometimes, a context of technological 'know how' as to what goods can do and how." (Lancaster 1971 p7).

Assumption 1.3   "Individuals differ in their reactions to different characteristics, rather than in their assessment of the characteristics contents of various goods collections. It is the characteristics in which consumers are interested.   They possess preferences for collections of characteristics and preferences for goods are indirect or derived in the sense that goods are required only to produce the characteristics." (Lancaster 1971 p7).

Assumption 2.1   "All characteristics are quantitative and objectively measurable" (Lancaster 1971 p15).

Assumption 2.7   There is an implicit assumption of perfect knowledge on:-

                              a)   The characteristics content and price of all goods on the market (This becomes explicit as assumption 2.2 of Lancaster (1979)).
                              b)   The consumer's own preferences.

                              "The 'unit' in which a particular characteristics is measured . . . must be the same for all goods possessing the characteristic and maintained throughout the analysis" (1971 p15). If this assumption is not made, people can see the same good in different ways, and the same good may have its characteristic described differently at different stages in the distribution chain.   This would again make it difficult to compare individuals or aggregate demand. Lancaster does not analyse the impact of this.

                              "Sometimes, among the different

> properties of a good, some may be
> relevant to one individual, others to a
> different individual. One person may
> scarcely notice the existence of
> properties which to him are of little
> account in his decisions but are
> important to someone else.   A
> difference in interest and emphasis
> may lead to differences in the
> importance of various properties to
> different people, but if the properties
> are objective, all will agree on them"
> (Lancaster, 1971, p.6).

Lancaster is well aware that these assumptions do not apply to all cases and that "people may sometimes appear to 'see' properties of a good that are not seen by others and defy objective analysis" (1971 p7). Nevertheless he makes them the working hypothesis of his analysis and bases his approach firmly on them.

SUBJECTIVE AND OBJECTIVE

Lancaster assumes that the consumer is perfectly informed about the objective characteristics, and makes his or her choice on the basis of personal preferences which are subjective (and possibly quite irrational). In this way he is able to leave out psychological and perceptual aspects.

He does not require that goods can be objectively described in terms of all their characteristics, only those that affect purchase. Any characteristic that does not affect purchase is not a characteristic under his definition. This does raise the question of what to do with a characteristic that is important to some consumers and irrelevant to others. This seems to be answered by Assumption 9.8: "A characteristic is totally irrelevant if it does not appear in consumers' preference functions ('satisfies his wants') either positively or negatively. Since we are concerned with aggregate market behaviour in typical applications of the model it is sufficient for total irrelevance that the characteristic does not appear in the preferences of a large proportion of the consumer population. We can often also rule out a characteristic that has a very low weight in preferences . . ." (Lancaster 1971, p146). This would appear to mean that minority tastes can be ignored. The relevance of a theory of quality in consumer demand that excludes such factors is questionable.

Lancaster uses the word "objective" as though there was one single way of identifying and measuring the characteristic that everybody agreed on. Popper (1973) prefers to think in terms of there being some objective reality which we can

only perceive imperfectly. If this distinction between subjective and objective is accepted, Lancaster's assumptions would be restated as follows:-

-        For each objective characteristic each buyer has one and only one corresponding subjective attribute.

-        The purchase decision is made on the basis of this subjective attribute.

-        There is a perfect correspondence between each individual's attribute and the objective characteristic.

-        All buyers have the same attribute - it is perceived and measured in the same way.

There are several ways in which these assumptions may be made more realistic. The assumption that there should be perfect conformance between characteristic and attribute (a matter of the perception of the individual) may be dropped. The assumption that there is perfect knowledge on the characteristics content of the good can be dropped. Various alternatives to the assumption that all observers have the same attributes can be considered. Some possibilities are set out below.

One possibility is that the buyer continues to buy according to the attribute, but, for reasons of perception or information, there is no longer a perfect correspondence between the level of attribute and the level of the characteristic. There could be a more or less random error, or a systematic error, as when a consumer perceives Brand X as being better than Brand Y. The implications depend, in part, on the amount of confidence with which the buyer believes he or she is correct. If all buyers have the same misperception, their curves may be plotted against the attribute. Someone with a different perception of what objective reality was, (the economist carrying out the study perhaps) could then rework the data, plotting them against his or her own attributes.

Let us take the situation where a single consumer's perceptions are plotted against his or her perceived level of characteristic (i.e. an attribute). If the consumer's indifference curve relative to these attributes corresponds to Lancaster's assumptions, his or her indifference curve corresponding to objective characteristics, may not - an unfounded belief in the sweetness of Jaffa oranges and an unfounded mistrust of Moroc, may result in two points on the indifference surface being "misplaced" with respect to objective sweetness. The result is that the indifference surface relative to objective level of characteristic becomes oddly shaped, and is no longer in conformance with Lancaster's assumptions.

There may not be one characteristic for each attribute. For example the attribute "sweetness" may be linked to the amount of sucrose, dextrose, fructose, sorbitol, saccharine, or asparteme in the product. Some consumers may be perfectly neutral

between the source of the sweetness (in which the objective characteristic may be something like the ability to stimulate receptors in the individual's brain - objective, but not objectively measurable). To a diabetic or someone trying to lose weight these sources of sweetness are quite distinct, some being harmful, some beneficial.

Conversely, a single characteristic may relate to several attributes, as sugar content can give attributes like sweetness, calories, carbohydrates, danger, or medicine to a diabetic. This difference in attributes may occur even when there is perfect knowledge and perfect perception of the objective characteristics.

With many products both effects are seen, many characteristics combined to produce an attribute like comfort, while a single characteristic like engine size gives distinct attributes like power and fuel consumption.

In this case one can end up with a single good (a given characteristics mix) which is seen by different consumers as being in different groups of goods. One buyer sees a car as something to get him to work, another as something to pull a caravan, another as something to let her visit her mother at week ends, another as a way to assert his virility. Each will have a set of attributes for a given model of car, relating to the end use. Similarly a chocolate bar may be perceived as a source of energy, a pleasant taste and texture, a symbol of a mother's love for a child, a child's assertion of its superiority over other children and so on. In each of these roles it has a different set of substitutes.

A characteristic may have no matching attribute. This can happen where, for example, the buyer is not aware of the possibility that lead in paint is poisonous, and so does not have any attribute relating to the lead content. A slightly different case arises where a food additive, say monosodium glutamate, affects the consumer's perception of taste directly, but the consumer is not aware of the existence, or possible existence, of the additive. Lancaster assumes away characteristics that do not affect decisions - this is one which does affect decisions, but which the consumer is not aware of. Imperfect perception can result in the buyer seeing a different characteristic, not just misjudging the level of the characteristic. An advertising campaign may give new information to someone, bringing a new characteristic into his or her perception.

An attribute may have no corresponding characteristic. A buyer may believe that a product is lucky, safe, beautiful and so on. A buyer may believe in a non-existent characteristic like the dietary-fibre content of beef. It would be possible to plot one individual's indifference surface with "perceived dietary fibre content" as an axis, even so. The interpretation of two such indifference surfaces, when one of the buyers believed in the existence of the characteristic and the other did not, is obscure. Not even an omniscient observer could plot the curves against the objective characteristic because there is none. Aggregation of a non-existent characteristic is impossible. Aggregation of beliefs in the existence of a non-existent characteristic is

outside the paradigm.

An attribute may not relate to the item purchased (the good), but to the brand, the product line, the shop where it was bought and so on. A product bought from Dior, Marks and Spencer, or Woolworth's carries an attribute additional to the characteristics observed at the time of purchase. One attribute may be the probability that an item in that shop is faulty, while the objective fact is either that the item bought is faulty or that it is not.

An attribute may not relate directly to characteristic at all, but to the buyer's perceptions of other people's perceptions. A good has the attribute "fashionable", "in good taste", "popular" and so on, if the buyer believes that a subjectively chosen set of people approves of it. There may be some element of this in the attribute "beautiful".

LANCASTER'S SUBJECTIVITY

It has been pointed out above that while Lancaster assumed objective and objectively measurable characteristics, he was not able to work within these assumptions: the factors used for his automobile example were highly subjective and not objectively measurable.

Lancaster appears to have been constrained by his desire to use a limited number of "characteristics" rather than the full specification of each automobile; by the need to cut the variables to a manageable number; by the desire that his model should be obviously relevant; and by the desire that the "characteristics" used should be positively demanded. This does raise the question whether objective characteristics can in fact be used with his theory.

He has moreover incorporated subjective assumptions in his theory from the very beginning. The following are assumptions about the subjective preferences of individuals:

-       The assumption that subjective attributes correspond exactly with characteristics.

-       The assumption that there is no quiddity, that a motor car is perceived not as a motor car, but as a bundle of characteristics.

-       The assumption of additivity, that characteristics from two goods can be combined is not an assumption about the goods: it is an assumption about the personal preferences of the individual.

-       The assumption that the protein from steak is a perfect substitute for the

protein from potatoes is an assumption about personal preferences. A vegetarian will not agree even though the amino acid content is identical.

-       The assumption of linearity - that two pounds of sugar has twice as much of every characteristic - seems unexceptional at first sight, but the statement that two oranges are twice as sweet as one shows its subjectivity. Similarly statements that two Ford Sierras are twice as fast as one, or that two Mona Lisas have twice as much of every characteristic as one, show that a subjective element must be assumed.

-       The assumption that all characteristics are positively desired (so a Mona Lisa would be better if it had more red paint) makes far-reaching assumptions about subjective preference.

-       The assumption about the shape of the indifference curve is an assumption about subjective preference.

-       The assumption of quantifiable, measurable characteristics is an assumption about the buyer, not the good.

It has been shown above that Lancaster has had to make sweeping assumptions about the subjectivity of buyers. This means that one of the biggest attractions of his model, that it appears to offer the possibility of building an economics based on objective quality, falls away. It becomes a weakness instead: where other traditions recognize subjectivity and try to take it into account, he ignores it.

BUNDLES AND GROUPINGS

In the last two chapters it has been shown that each new characteristic or attribute used in making a purchase decision implies another dimension, and a very much more complicated decision. If all the dozens of characteristics of a product were taken into account the analysis would be impossible.

Here it is argued that consumers bundle together characteristics into broader groupings to make the data manageable.

For example the food scientist looking at onions is concerned with how the propenecysteine sulphoxide in the onion reacts with the enzyme alliinase to produce the propenesulphenic acid content, which breaks down to form either propanethyl oxide, which makes the eyes water, or thiosulphinate, which gives the raw onion smell, and which turns in the frying process to the sweeter smell of bispropenyl disulphide (Emsley, 1989). At this stage some quality analysis based on chemical

content may be appropriate. One step later in the chain, all these characteristics and reactions are bundled into two, pungency and flavour, as the plant breeder and agronomist try to develop onions for different markets, while at the same time developing characteristics in other groupings like "keeping quality" (arising from such characteristics as thin necks and many skins) or appearance. The consumer may rank flavour as good or bad, or even take it for granted, and buy mild, attractive, Spanish onions for salads, and the more pungent, brown skinned varieties for cooking. A final level of attribute bundling is the product quiddity: "that is an onion".

What appears to be happening here is that the food scientist has attributes which in one sense correspond closely to the objective characteristics. Attributes like this are of limited value even to a food scientist, so they are bundled together to produce another attribute, taste. In this case there seems to be quite a lot of agreement, on attributes like pungency and sweetness, but less on the attribute "good flavour". Even allowing for all the subjective elements in deciding which attributes to combine into the bundle "pungency" and the weighting to be given to each, it is clearly far more useful to a buyer to know that an onion is pungent than to have a listing of its organic sulphur compounds.

The individual may benefit from such a bundled attribute even if he or she is the only person to have such an attribute. In marketing and economics though, it is difficult to deal with a situation where each individual has a different set of attribute bundles. It would be convenient if all people had an identical set of attribute bundles, or, failing that, if the buyers in each market segment had the same set of attribute bundles.

Some of the broad groupings or bundles which are commonly used in evaluating a product, are safety, performance, aesthetics, features, environment, price, value for money, durability and confidence. It seems likely that there is a group of features, any of which would lead to the consumer thinking a car is safer. These include insurance group (a quality cue), brakes, roadholding, seatbelts, air bags and side crash bars. These each have a different effect but each may be interpreted as in some way reducing the chance that the driver or his family gets injured in a crash. Individuals cannot be expected to agree on what attributes to include in the bundle "safety", much less on how to measure them and on what weighting to give them. They may, however, be in agreement that safety is important.

There may be significant overlaps in the bundles, with the same attributes affecting performance, durability and reliability of a car for instance. This will certainly be the case if the quiddity ("This is a motor car") is taken as an attribute bundle.

The same attribute bundles may be used for many completely different product groups. Safety, performance and aesthetics are applied to food, cars and houses. The components of safety may be completely different for each product.

An important point is that in many examples that spring to mind, consumer demand is positively related to level of attribute bundle (e.g. the "greener", the tastier, the safer it is, the more it is wanted). Chapter 5 has shown that demand is much less likely to be positively related to the level of the objective characteristics on which the bundle is based. That is to say Lancaster's assumptions on a positive demand and price are most likely to apply when there is most subjectivity. Even if this is a widespread phenomenon, rather than the norm - and it is not suggested here that it is universal - it must cast further doubts on the applicability of Lancaster's theory.

It may be asked, therefore, if we can achieve a common set of attributes by disaggregating the bundles. If we use a very aggregated bundle like taste, there may be wide separations in perception, while if we move towards sweetness and pungency, there is more agreement, more "common subjectivity" and with organic sulphur compounds there will be a wide degree of common subjectivity among food chemists. In fact we have no reason to believe that this will normally be the case: there may be more agreement about the taste of a chicken Tikka than about the flavours that go into it. The fact that a hundred scientists working on onions have a perception close to objectivity does not mean that any decisions whatsoever are made on their perceptions. Nor does it mean that anyone buying at wholesale or retail knows of the existence of organic sulphur compounds. (This is a strong reason for questioning the importance of "market transparency", using the same attributes throughout the marketing chain).

WHAT LEVEL OF BUNDLING?

We might choose to describe the attributes at any level from the location and performance of a good's sub-atomic particles to its description in terms of half a dozen attribute bundles, or a single quiddity. Which is the appropriate level to choose?

Differences in training and approach mean that economists are more likely to want to use something measurable, marketing professionals to analyse what factors appeared to affect actual purchase and psychologists to find out why buyers "really" made the decision. In general, one would want to work initially in terms which most buyers or sellers would recognize or use themselves. Switching to a different set of attributes which they do not recognize requires justification. The various aspects a psychiatrist would take into account in finding out the reasons why people bought one car rather than another, which may include sex, status and image, for instance, do not fit easily into economic models. In common language cars are not in fact described in this way, even if advertisements try to sell the image. Nor are they described in terms of the services they provide, transport, speed, carrying goods and so on. They are described in terms of reasonably neutral descriptions of engine, body and trim plus brand and model. The fact that this method of description is seen by a wide range of buyers as a basis for describing the quality of the cars to others is a powerful

argument for using it. One could speculate at length if this description indicates the attribute they "really" want subconsciously, or whether, as the Edsel example suggests, people buy what they think they want rather than what they really want. One could speculate on the extent to which such a common language encourages people to adopt a certain mindset when appraising a car. It could be, of course, that they are too shy to reveal their "true" feelings and either hide them, or talk in terms of "power" or "fuel injection" instead of sexuality. It may be that they select a brand and model for its image, status and sexuality, but choose the features - 5 door, 1800 cc, GL, and so on as additional features, or alternatively that they take a hard analytical decisions on the basis of engine, reliability, trim, price and so on, and find that half a dozen models and specifications are close substitutes: they then choose an image, sex, and status as tie-breaking features (two versions of a sequential search pattern). In the latter case, the specifications are a very meaningful form of description.

ATTRIBUTES CHANGE: CHARACTERISTICS STAY THE SAME

Another major objection to an analysis based entirely on objective characteristics is that there can be enormous changes in the attributes of a product over a period when its objective characteristics remain the same. This can arise, for instance through:

-       changing end use
-       changing the information available
-       changing search costs
-       changing advertising
-       changing availability and location
-       changing uniformity, tolerances etc
-       changing guarantees
-       selling in shops with a different reputation

Examples are the change in perception of the potato from an unhealthy, fattening food, to a slimming food and the changing image of the Filofax over 50 years.

A large part of marketing is concerned with precisely with these points, as are large chunks of economics outside consumption theory (eg. location economics, the economics of advertising, the economics of information, the economics of risk, and much of Chamberlin's product variation). Lancaster's assumptions, therefore, makes his theory inapplicable in a lot of the areas where interesting work is taking place.

One may look at the level of aggregation of attribute and the type of attribute used in some other descriptions. A product may be described:

-       by what it does e.g. it cures athletes foot, it washes clothes.

-        by what it is capable of doing, even if it never will do it (a car can do 150 miles per hour, a bridge can carry 100 tons).

-        by what its components can do (32 megabyte hard disc).

-        by what its ingredients are (15 grams of fibre).

-        by what processes it has undergone (Halal, hand made, BS 5750).

-        what it is: a Rolls Royce may be valued for being for being a Rolls Royce independently of being a means of transport, a mix of components and so on.

It is not unusual for a product to be described in several of these ways simultaneously, for instance: Daimler, Sovereign, 6 cylinder, 423 cc, OHC, 11.23 miles per gallon, air conditioned.

Interestingly, a product may be normally described in one fashion when it is valued in another. A radio, for example, may be described in terms of its components or specifications, when it is valued primarily for the content of the programmes the buyer listens to, which have nothing to do with the specifications (A technically perfect radio would be useless if there were no programmes transmitted). Similarly, a car or a house is described in terms of its specifications rather than the stream of services it provides over its lifetime. One reason for this is that when there is a big range of possible uses, it is not useful to describe it in terms of no interest to most people. There may be a trade-off between precision of description and generality of application.

PRICES

Similar problems arise with prices. It is convenient to assume that each buyer has a price list, giving the prices for each combination of characteristics available. Once it is accepted that the buyer has imperfect perception of prices and imperfect knowledge, this can no longer be assumed, and it cannot be assumed that a buyer is able to plot prices against objective characteristics. At best, he or she can plot their perception of price against their perception of characteristics. Because of this, even if he or she believes that there is a price function like that assumed by Lancaster, the curve might be very different if actual prices were plotted against actual characteristics. Conversely, if prices conformed to Lancaster's assumptions, their perceptions might not - and their decisions are made on perceptions.

No two consumers will plot possible prices against perceived level of characteristic in the same way, even when they have the same information about the prices of goods available, as long as they have different perceptions of their characteristics

mix.

There are further complications if it is admitted that, in fact, people do not all pay the same prices.

CONCLUSION

One of the biggest attractions of Lancaster's theory is that it offers the possibility of working on "hard" data, objective characteristics, rather than on the softer data of perceptions, beliefs and emotions. This is appealing to economists who may prefer a harder approach, and it means that the expensive process of determining beliefs and perceptions can be avoided.
Lancaster's theory is based firmly on objective characteristics. If one accepts that people base their decisions on imperfect perceptions and imperfect knowledge, his whole theory falls away. It can no longer be used for an individual to plot his or her preferences against objective characteristics and it is not possible to see how individuals' choice is affected by changes in objective characteristics. Still less is it possible to compare individuals' preferences, or to aggregate individual preferences.

In the real world, there is imperfect knowledge, imperfect perception and uncertain beliefs. These have given rise to approaches like those of information economics, and marketing. Indeed, much of what is done in marketing and advertising, particularly outside agriculture, depends on the existence of these perceptions. It may be that cases do exist where it would be reasonable to assume them away, but they do not spring to mind, and Lancaster does not argue the case.

The enormous number of objective characteristics of a product (even the production specifications are a far from a full listing as the onion example shows), means that they are not in practice used for decision making. Attributes are used rather than characteristics, and several characteristics may correspond to one attribute and several attributes may be bundled together to make another attribute. Decisions may be made on bundled attributes like comfort, power, safety, taste, beauty and texture. This implies of course that some consumer preference moves from the indifference curves to the construction of the attributes.

This means that many purchase decisions are made on factors very far removed from Lancaster's objective characteristics. Often, the more subjectivity is included and the further one is from objectivity, the closer we get to a situation where an attribute is positively priced and valued. It becomes increasingly difficult to argue that decisions are based on objective characteristics.

Other approaches recognize that imperfect knowledge and perception are universal, and build them into the theory from the beginning. They have developed techniques

that address the problems raised here, however imperfectly, rather than assuming them away. Lancaster, on the other hand, has started by assuming away these universal and important features of real markets.

OBSERVING INDIFFERENCE CURVES

It has been shown in previous chapters that it is unlikely that indifference curves anything like those assumed by Lancaster exist in most cases. As his assumptions on indifference curves are fundamental to all his analysis it must be taken that the analysis only applies to certain special cases. Indeed, Lancaster was quite emphatic that his model was not meant to apply in all cases. Similar problems arise with the prices assumed. If these are special cases where Lancaster's theory is applicable, this is only of interest if it is possible to say "The theory should work in this case, it need not work in that case". In this chapter I ask whether it is possible to make such a statement.

The first problem that must be solved is to ascertain that curves approximating to Lancaster's indifference curves do exist in this particular case. If it is not possible to say "For this product in this market, the vast majority of indifferences curves are of the form predicted by Lancaster, so based on his analysis I predict that ...", it is not possible to come up with any testable hypotheses - it will always be possible to say "Of course it did not work, the assumptions are probably wrong, and Lancaster's theory was not meant to apply where the assumptions do not apply." If it is not possible to say in advance that the theory applies to this particular product in this market, could it be possible to say ex post that the indifference curves were as he predicted in a specific market? This information would be far less valuable, but not entirely useless - it would mean, for example, that a great many analyses would have to be carried out for every one that proved meaningful. However the quality of data and argument needed for this ex post analysis must be far higher than just "the assumptions must be right here because it seems to work".
Even if it were possible to know that the indifference curves did meet Lancaster's assumptions, the information would be of no value if they could not be measured and plotted. It would not be possible to use a generalization to predict the impact of introducing a new product at individual or market level. Another possibility to consider is that the curves can be plotted, but only in a way that makes the analysis impossible.

In this chapter therefore, it will be asked whether indifference curves can be identified and measured by an observer.

     1   with Lancaster's assumptions?
     2   with changed assumptions on attributes and characteristics?
     3   with changed assumptions on knowledge and calculation of optima?

Perfect Knowledge about Characteristics

This section will examine first how an indifference curve might be plotted when two of Lancaster's assumptions hold : when there is perfect information, and where there is one attribute for one characteristic.

The first question is what sort of space the indifference surface should be plotted in. In chapters two, five and six it was shown that there were several different spaces, though Lancaster called them all characteristics space and slipped from one to another without noticing. However the space for the least cost diet example was quite different in kind from that used for a group of goods or for a unit product like cars. In one space it is possible to plot milk, eggs, sirloin steak, oranges and bread; in another it is possible to plot motor cars, but not vans, trucks or motor cycles. Individuals may vary in which space they make their decisions and which characteristics are relevant to their decision. A bottle of wine may appear in several spaces, relating to calories in the diet, flavouring in a meal, which red on the wine list or which claret. These evaluations may occur sequentially, or much at the same time. The axes and shape of the curves may be very different, but there is no way an observer could determine which is appropriate from observing purchases. This in itself is a fundamental problem, which is enough to invalidate any analysis based on the theory.

The last two chapters have shown how complex both indifference surfaces and price lists can be, and even the very simple indifference curves assumed by Lancaster lead to complex decisions if half a dozen attributes or characteristics have to be taken into account. This raises the question "How many points have to be observed on a single indifference surface curve to define it?"

A product may have, say, seven salient attributes on which decisions are made, implying seven-dimensional price and indifference surfaces plus quantitive. Each two dimensions may produce a curve of the complexity indicated in Chapter five. Five observations on a single two dimensional indifference curve are unlikely to give much indication of the shape of that curve, and a very large number would be needed to indicate the shape of a single seven dimensional indifference surface.

Given that one has a limited number of possible observations, how can one plot, an indifference curve on two dimensions of a seven dimensional indifference surface? Changing prices noting what was bought would be one approach, increasing the price of the preferred good until it was replaced by another one, on the same or a slightly lower indifference curve. The replacement might, however, be identical in these two characteristics/ attributes, but different in some or all of the others. An alternative would be to take the good that is bought, remove it from the market and replace it with goods with different levels of the two characteristics, and seeing which are bought at the same price, a long process of trial and error. The results may

be an indifference curve quite different in shape to that of a close substitute (i.e. on the same indifference surface with different levels of the other five characteristics). The interpretation of the results is difficult as some characteristics will be neutral or negatively valued. The experiment for each good would be quite different and the availability of substitutes of completely different characteristic mixes would complicate the experiment. Since each individual may be expected to have a different indifference surface, the experiment appropriate to measure one buyer's indifference curve would not measure another's. The process would have to be replicated at different budget levels to produce different curves.

How many observations can be made? Given that few goods are bought as often as once a week, given that preferences change (with the weather, with the season, and with public holidays, for instance), that perceived budgets change, and that prices within the group of goods and substitute goods change over the year, it would be unusual for there to be as many as five observations that are comparable. Even with, say, 50 goods (product lines) within one group on offer, there may not be more than, say, five or ten on any one indifference surface, and the price structure may be such that only one or two of these is bought - which is not a reason for ignoring the others : on the contrary, one of Lancaster's objectives is to help position new products. With many goods like cars, houses or stereos, there will be only a single purchase, so it is only possible to plot one point on an indifference curve and it many not be on a budget line.

If conclusions are to be drawn from observations, then budgets, preferences and prices, including prices for substitutes, should be constant. It is not easy for an outsider to observe actual budgets and not possible to observe perceived budgets. Preferences change with season, with weather with public holidays and over time. Indeed Van Trijpp (1989) argues that there can be a constant demand for variety : even when preferences, budget and prices are constant, there will be different purchases. This means that one would be reluctant to assume <u>ceteris paribus</u> if observations were collected over any length of time.

If the consumer is perfectly informed about the quality and price of all possible purchases, and if the observer has the same information <u>and</u> knows that his or her perception is identical with that of the consumer, then a purchase conveys quite a lot of information. It shows that in that situation, at that moment in time, anything that is cheaper lies on a lower indifference curve, and anything that is the same price lies on the same, or a lower indifference curve. This information is of limited value unless it can be shown that all characteristics are positively valued at all times. It also assumes that price is not a quality attribute.

Quantities

When dealing with goods like houses and cars, it may be possible to have an

indifference curve which does not take quantity purchased into account, though since there is typically only one purchase, (or perhaps two) indifference surfaces cannot be plotted from observations. Furthermore, these purchases are typically not on the budget line. With most goods, though, quantity is a factor : one may buy more of an inferior good. (Frequency of purchase may approximate to quantity purchased).

The relationship between quantity and utility is purely subjective. In his basic model Lancaster assumes that two units of a product have twice as much of each characteristic as one, but not necessarily that they give twice as much utility. This is an assumption about each individual's perceptions, not about the product. It clearly does not apply in his automobile example : two automobiles do not have better brakes than one.

In the basic model additivity is assumed. It is assumed that the consumer does not mind whether protein comes from steak, potatoes or a mixture. The information required is then the total quantity of characteristics in the diet as a whole. This means noting the quantity of all purchases and their characteristics, not just working on purchases of different cuts of meat or types of coffee.
What is plotted here is not the characteristics attribute content of an item, but the total characteristics/attributes contents of a diet. The characteristics to be plotted depend on the individual consumer's preferences. The fact that one combination is bought suggests that any cheaper combinations are thought inferior.

A major problem with the basic model is the assumption that all products are consumed the moment they are bought. With Lancaster's example of the human diet, this is clearly not so. Milk may be bought daily, meat weekly, baked beans fortnightly, sauces monthly and spices once a year, for instance. If prices, budget or demand change over this period, it is impossible to plot an indifference surface.

With other models, when plotting someone's purchase of apples for instance, quantity purchased must also be noted. Again it is a matter of assumption that a buyer perceives that 2 pounds of apples have 2 times as much of all characteristics as 1 pound.

The assumption of one attribute per characteristic and of perfect knowledge does permit other possibilities. Each buyer can have an attribute that is correct but different : A perceives a 1600 cc engine; B perceives an engine which can pull her caravan; C perceives a quiet engine, D perceives an engine with fast acceleration from standstill; E perceives an engine which can accelerate to overtake when cruising; F perceives a V8 injection, G perceives a clean engine, and so on. Each attribute is directly related to the objective engine and each is correct. However, the consumers will not agree about the ranking of different engines, much less their cardinal measurement, An outside observer cannot deduce from purchase patterns which attributes are being used by the buyer : he or she can only plot actual purchases against his or her own perceptions or what he or she perceives some one

else's perceptions to be. Again, this means both that the outside observer cannot plot an individual's indifference curve, and that because indifference curves are plotted on different axes, the comparison of individuals and aggregation is not possible.

Other Attributes

There are other types of attributes which are compatible with the assumption of perfect information. For example, :

-        The buyer may be perfectly informed about a characteristic but have an attribute that is very different in kind - the buyer's perception of beauty for instance.

-        The buyer may be perfectly informed on the characteristic but have an attribute "in fashion" which depends on his or her perception, (possibly perfectly informed) of which other people perceive it to be in fashion.

-        The buyer may have an attribute which is related to two or more characteristics.

-        A single characteristic may contribute to two or more attributes.

In the first case where the attribute is based on, but different to a characteristic, it is unlikely that the attribute is linearly related to the characteristic. The outside observer will not know which way of measuring the characteristic is used by the buyer or, indeed, which characteristic is being used. It is quite likely that he or she would try and plot the purchases against the wrong characteristic entirely, the subject of a picture rather than its composition perhaps. Even with a very large number of observations the problems of determining the relationships are very difficult. With the half dozen comparable observations that are likely in practice they are insuperable.

Each individual or each market segment might have a different attribute for a given characteristic, or they might relate the same attribute, "sweetness" perhaps, to very different characteristics. This makes interpersonal comparisons and aggregation impossible when the only information available is what was bought and the price list.

When the buyer is concerned with what is in fashion, the key factors in decisions are perceptions about the beliefs of people in his or her peer group. The observer does not know the consumer's beliefs, or who is in his or her peer group. In the short term the consumer may take one characteristic, colour, perhaps, or several characteristics as indicating fashionableness and buy accordingly. In the short term it may appear that he or she is getting utility from these characteristics, though they are proxies for something else. In the longer term fashions and beliefs change. The

marketing implications of the two are very different. Again, no two consumers need have the same attribute. Those that share an attribute may take different decisions : "if the Sloanes are wearing them I wouldn't be seen dead in one". In this case it is impossible to observe.

An attribute is often related to two or more characteristics. The outside observer cannot know (a) to which characteristics, (b) to which measures of the characteristics or (c) how the measures are brought together to create an attribute.

If the observer did know, as a result of interviewing the buyer, which measures of which characteristics were taken into account, the observations could be plotted against the characteristics. The result would be that a decision based quite closely on an attribute appears to be based distantly on any one characteristic - and the result of putting all the characteristics in, is to create several new dimensions, dramatically reducing the usefulness of the limited number of observations possible.

A single characteristic may affect several attributes possibly in different directions, as increased engine size may give improved power and "worse" fuel consumption. In this case an outside observer, basing observations only on the "objective characteristic" of engine size might find it was not apparently realted to purcahse, when in fact it strongly contributed to two important attributes.

Imperfect Information

Perfect information is an extremely unrealistic assumption and it can only be justified when it is used to focus part of an analysis on other aspects. It if it used for the whole of an analysis, as in Lancaster, it means that none of the analysis has been looked at in the light of reality. In reality:

1.   Individuals do not know their own utility functions.

2.   They do not know what characteristics will meet their needs.

3.   They do not know what goods have what characteristics.

4.   They do not know the prices of all characteristics.

5.   They cannot calculate optima (as the previous chapters have shown).

6.   There is information overload.

7.   Many adopt satisficing rather than optimizing criteria.

8.   Many adopt heuristics like habitual purchases, or searching behaviour.

Under these conditions, the fact that one good rather than another was bought no longer means that it was on the same or higher indifference curve. It might mean, inter alia, that:

- the good was correctly perceived by the buyer and so were its alternatives.

- the good bought was correctly perceived, but its alternatives were undervalued.

- the good bought was overvalued, while alternatives were correctly valued.

- some combination of the above, such as that they were all overvalued to different extents.

- some heuristic was applied such as a habitual purchase pattern, in which the alternatives were not valued, but the effect was nevertheless the same as one of these.

- The buyer panicked.

The error may arise from incorrect perception of any of the characteristics.

Two other situations arise here, one where an attribute has no corresponding characteristic (it is imaginary) and one where an important characteristic has no corresponding attribute. These are extreme forms of imperfect information.

For these reasons it is unlikely that any purchase will, in fact, be optimal, in terms of outlay and utility. There will be three kinds of deviation.

a) Systematic, when for example Brand X is always overrated or certain attributes/characteristics are always underrated. (This implies that they are always underrated compared to some criterion, perhaps perception at time of purchase compared with perception at time of consumption).

b) Bias, when errors are more likely to be in one direction than in others.

c) Random, when errors are as likely to be in one direction as in another.

A further complication arises. Observers cannot be assumed to have perfect knowledge of the price and characteristics content of all alternatives. They have their own perceptions of the attributes. They may be better informed about the characteristics because of their job (that is to say their attributes correspond closely to one possible measure of certain characteristics). In this case their attributes are unlikely to correspond exactley with those of the buyer. When they are trying to plot the buyer's purchases, they must imagine the buyer's attributes and the relevant

characteristics. They must also imagine what the buyer perceives to be the characteristics content, the price and availability of possible alternatives - or just leave them out of the analysis entirely.

Any one purchase may therefore be an error, a purchase not determined by the indifference surface or the iso-cost curve surface. Even if there were a large number of observations, it would not be possible to work out the "average" purchase for any situation. The choice is made on several characteristics, so the result of a slight error on one characteristic may mean that the buyer switches to a very different product, possibly at the "opposite" end of an indifference surface.

If there are only a few observations, the observer will have no reason to believe that any one of the observations actually does lie on the indifference curve iso- preference curve. In most situations the observer would have no idea of the level of error that was possible or the possible effects of the cumulative error. (It is no doubt possible to imagine a situation where the observer would have this information, but it is sterile line of research). It must be concluded that in this case multi dimensional surfaces cannot be plotted.

Indifference Curves or Iso- Preference Curves?

Once it is accepted that the buyer does not always buy the good that maximizes his utility, it must be asked what an indifference curve means.

Lancaster (1971) p21) takes indifference curves to be the contours of a utility function and then:

> "Finally, we make the essential behaviourial assumption without which our preference structure would be useless : The consumer acts in accordance with his preferences, that is, given the opportunity to choose from some set Z of characteristics collections the consumer will choose that collection which maximizes a (z) over Z." (1971 p21).

There are two concepts here, utility and what people actually buy. Here the term "indifference curves" will be used when referring to utility and "iso-preference curves" when referring to what people actually buy. Lancaster assumes that the two are the same, but this can only be so if:

a)   The consumer is perfectly informed about the characteristics content and price of the alternatives - or at least of those goods which are realistic alternatives.

b)   The consumer is perfectly informed about his or her own utility function, implying inter alia that he knows which characteristics will meet his or her

needs.

c)   The consumer is capable of doing the calculations necessary to maximise utility from this information.

d)   There is a one-to-one correspondence between attributes and characteristics.

e)   People have choice heuristics which maximize their utility.

The possibility of compensating errors may be ignored.

These requirements are so stringent that it may be assumed that in virtually all real-life situations there will be significant differences between the two.

Lancaster continues with his restrictive assumptions of perfect knowledge etc. throughout the analysis and never examines what will happen if there is in fact a significant difference between what maximizes utility and what people buy (and, still less, different perceptions over time). Once it is accepted that there is a difference between what people buy and what would have given them the greatest utility, one must ask which the analysis should be based on. Lancaster does not consider this, but he is working in a tradition where it is objective characteristics that matters and he keeps emphasizing objective characteristics.

Imperfect information usually means imperfect information about the price and availability of substitutes. Search for price is one of the fundamentals of the economics of information and the degree of consumer ignorance of the price and availability of substitutes is an important question in marketing. This implies that even consumers who correctly perceive the level of characteristics of all the options they examine may choose a sub-optimal good.

Difficulties in calculation mean that even the consumer who is perfectly informed about price will not often reach the optimal conclusion. Chapters 5 and 6 in particular have shown that even economists have not been successful in devising optimizing techniques, so it is unlikely that the average consumer will be very happy with n-dimensional supply and utility surfaces. The indifference surface is based on the decisions actually made, not on preferences, so there is no problem if a consumer consistently makes the same error.

CONCLUSION

If a theory is to be of any practical application, it must be possible to say that the assumptions apply or do not apply in a particular case. It has been argued here that it is impossible or impracticable to demonstrate that in any particular case the

indifference curves of individuals correspond to those assumed by Lancaster. Very little can be learnt by observing actual pruchases.

If one moves outside the paradigm, to psychological or behavioural approaches for instance, it is possible to find out more about indifferences surfaces with respect to attributes. This is not however within the Lancaster paradigm. It also loses one of the great attractions of Lancaster, that it works with easily and cheaply observed objective characteristics.

CONCLUSION

THE OBJECTIVE

The objective of this refutation was to determine the limitations of Lancaster's theory of quality in consumer demand when applied to real-world economics. The theory was subjected to testing in the expectation that one of the following would be the outcome:

- The theory would survive unscathed, in which case researchers could build on it with greater confidence.
- Limitations would be identified, and if we knew exactly where they applied, the theory could be used only where appropriate with the result that the theory is strengthened.
- The theory would be shown to be of no applicability, to have conflicting assumptions, or to have incorrect logic, in which case we may abandon it or replace it with one of the many approaches which are current in the economic literature (see Chapter Four).

METHODS OF TESTING

In Chapter One it was shown that theories must be tested differently from models. A model of a specific product in a specific market could be tested on the realism of its assumptions, the correctness of its logic or the accuracy of its predictions. However, most economic theories, including Lancaster's, are not intended to apply to a specific market, so neither their assumptions nor their predictions can be tested in this way. They have other purposes: they may, for example, present a string of logic or a paradigm which can be borrowed for a specific model or they may present a "what if" scenario, to inspire empirical research. This implies a different approach to testing.

TESTING THE THEORY'S PREDICTIONS

Lancaster's theory does not make direct predictions about the real world, and so is not directly testable by its predictions.[29]

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[29]   This refers to his core theory: it would be easy to pick examples of where he does appear

It could be argued that the theory can be tested by whether specific models which have Lancaster's theory as one component are successful predictors. This raises questions about what is a meaningful test and how many such tests are necessary.

I know of no attempts to carry out a crucial test of models using Lancaster. A test requires that a specific model making use of Lancaster's paradigm makes predictions which are reasonably accurate, and particularly that it makes predictions that are not made by models using any other theory. However, it requires very careful modelling to devise a test that is crucial in this sense, with models based on different theories potentially predicting different phenomena. It also requires luck to find a situation where the data actually results in predictions of different outcomes. The competing theories were, after all, designed to deal with the same problems and most have a common origin. Testing in this way is also limited by the fact that competing theories do not all share the same boundary assumptions and so cannot all be used in a specific market situation, making comparisons impossible. A further problem that makes crucial testing difficult is that the theory is only a small component of the model so the success or failure of the model, may have nothing to do with the theory used.

The finding that in any one situation a model using one theory is a better predictor than another is not a crucial test. If it was found consistently in a large number of situations, with a range of specific models, it would produce some small corroboration for the hypothesis that the theory was better than competing theories. However, we can be quite certain that a theory that is "better" will not consistently produce more accurate predictions. Nor is it possible to compare theories with different boundary or fundamental assumptions. Again, the theory is only a small part of the model, so a good theory will often be let down by a bad model and vice versa. Data problems, noise, experimental error or external factors like changing market conditions will obscure the results. Often the theory actually used may bear little relation to the theory that is cited so the theory cited is not being tested (see Lancaster 1971, pp.113-4). Similarly Ratchford's (1979) criticism of Ladd & Zober's (1977) finding that some market level results appeared to be incompatible with the hypothesis that Lancaster applied everywhere, is powerful, criticising the use of market-level hedonic price functions as an indicator of an individual's preference function, when there is a very long chain of causation between the two.

For these reasons a very large number of instances would have to be recorded where models using Lancaster performed better or worse than models using other theories

to be making predictions about the real world, particularly in Variety, Equity & Efficiency (1979), but these generalized conclusions do not follow from his core theory, requiring at the least a large number of ad hoc assumptions. His theory is much stronger if they are ignored.

before we could draw any conclusions as to its relative predictive powers. Even so, adherents of any theory could easily reject any unwelcome results on the basis of the problems mentioned here so these results would not be generally accepted to be a refutation.

It was concluded that it was impractical to test Lancaster in this way.

A further constraint, more powerful than the others, is that it is not possible to test predictions of a model using the theory unless it is possible to state whether the assumptions hold in any case. It has been shown in earlier chapters that this was not the case with Lancaster.

TESTING ASSUMPTIONS

If a model has realistic assumptions and correct logic, it can be used to produce correct predictions. A theory's assumptions cannot be tested for realism in the same way, because it is not meant to apply to all situations. The assumptions are "wrong" only when they are self-contradictory or when they rule out all of reality. As Lancaster said of his 1975 paper:

> "At that stage it was not realized by the author that
> there are no viable market structures in the paradigm
> case, and thus there are important errors in the paper"
> (Lancaster, 1979, p.13).

Other criteria are, therefore, required to assess a theory's assumptions in terms of its application to real-world economics.

In Chapters Two and Three Lancaster's theory was set out and some 63 explicit assumptions were identified. These consist of:
1.   Boundary assumptions.
2.   Ad hoc and ceteris paribus assumptions.
3.   Fundamental assumptions on
         - individual preferences
         - supply
         - objective characteristics.
4.   Assumptions on the automobile example which did not share
         the same ad hoc and boundary assumptions as the rest of the
         theory.

SIMPLIFYING ASSUMPTIONS

Specific models of the real world must have simplifying assumptions if the model is

to be workable. If the simplification is done well, the model retains much of its realism. Criticism of simplification is justified if it is done badly, assuming perfect knowledge in a model of advertising, for instance, or oversimplifying to the point that the model loses its realism.

The assumptions of a theory, as opposed to a model, are generally simple, so the theory is a poor approximation to a wide range of situations, where a model is a good approximation to one situation and a very bad approximation indeed to most others (though this may change over time).

Since some simplification is always necessary, criticism of a model for over-simplification are unlikely to carry much weight, even if justified, and criticisms of a theory as being over-simplified are likely to be ignored, with some justification.

THE BOUNDARY ASSUMPTIONS

It is one of the strengths of Lancaster's theory that he sets out his boundary assumptions clearly from the beginning. These boundaries specify under what conditions the theory is expected to work. The theory is not tended to work in all real world conditions but only in one clearly defined sub-set of them. The boundary assumptions limit the application of the theory to cases where:

a)   The satisfaction from a unit of a characteristic is independent of the form in which that characteristic is supplied - protein in steak or potatoes giving the same satisfaction for instance.

b)   Any two or more goods may be consumed together and it is the total quantity of the characteristics consumed that determine the level of satisfaction achieved.

c)   There is linearity, three times as much of a good having three times as much of each characteristic.

Lancaster's model can work only where these assumptions hold. Without them none of his analysis can proceed to his paradigm cases.

In Chapter Four it is shown that past criticism of the theory has concentrated on the extremely restricted nature of its boundary assumptions. They limit its application to situations similar to a simplified version of the least-cost feed mix for livestock, and, indeed, Lancaster's theory is derived from this analysis. Hendler (1975) and Lucas (1975) had no difficulty in pointing out the absurd consequences of trying to apply the assumptions elsewhere. For example two medium-sweet apples would have to give the same satisfaction as one very sweet apple plus one with no sweetness; a salad would have to give the same satisfaction as its ingredients consumed separately; two size six shoes would have to give the same satisfaction as one size twelve and so on.

These criticisms are serious. Any theory with such limited application can be of very little value to an real-world economist. The theory gives no insight to what happens when its assumptions do not hold, and it is very rare that they would apply in real-world markets. Some economists reject it outright on this alone. Many others do not: only 1.5% of those citing Lancaster in recent years cited these criticisms.

AD HOC ASSUMPTIONS

Boundary assumptions indicate that the theory is intended to work in one stated area of reality. Ad hoc assumptions are introduced because the theory does not work with realistic, widely applicable, assumptions, and each ad hoc assumption creates a special case where the theory can apply. The ad hoc assumptions are not made to introduce more realism into a simplified model; they are introduced because the line of analysis cannot proceed unless further unrealistic assumptions are made.

Ceteris paribus assumptions are useful to concentrate attention on part of a theory or model at some stages in the analysis. They are essential for economic analysis, but it must be possible to drop them in due course before applying the model. If they are not dropped they are, in effect, ad hoc assumptions or boundary assumptions in disguise. Lancaster's ceteris paribus assumptions on perfect knowledge, instant consumption, no difference between characteristics and attributes and so on were never dropped.

It was shown in Chapter Three that at least forty of the assumptions in Lancaster are ad hoc having no purpose except to make further analysis possible. Each confines the analysis to a smaller and smaller area of reality and even at an early stage it is difficult to imagine any real life situation to which they could apply. A further danger of ad hoc assumptions is that each explicit assumption introduces implicit assumptions, so it becomes increasingly likely that conflicting assumptions have been introduced unknowingly.

In Lancaster's theory the problem is made many times worse by the fact that most of the ad hoc assumptions are non-operational in the sense that it is not possible to identify whether or not they hold in a particular situation. For example, it was convenient for Lancaster to make the uniformity assumption on the distribution of preferences, that, in geometric terms, the transformed indifference curves in specification quantity space are all of identical shape and are tangential to the unit product differentiation curve at the specification corresponding to the most preferred good, but there is no conceivable way in which one could determine whether this assumption applied in any case.

For this reason, at any stage after the first few ad hoc assumptions have been made one can say that there does not exist anywhere in the world, any set of characteristics or any set of goods in any market for which the majority of consumers have

preferences that in any way resemble those that have been postulated, and be perfectly certain that nobody can produce an example to disprove this statement.

The fact that Lancaster felt that it was necessary to make these ad hoc assumptions implies that he recognized that his theory did not work without them. He states that one of his objectives was to build up a theory with the minimum of assumptions, so it is clear that they were not introduced casually.

For the reasons given above it was not considered necessary to produce examples of contradictions introduced by explicit or implicit assumptions. In addition, it would be rather pointless, as one can easily replace one set of ad hoc assumptions which are known to be wrong, by another which are not yet known to be wrong, as long as there are no constraints to the introduction of ad hoc assumptions.

These criticisms can be avoided by cutting out the ad hoc assumptions and leaving a theory based on the fundamental and boundary assumptions. This is far wider in application (limited only by the restrictive boundary assumptions) and far harder to refute, but it makes far fewer predictions. In effect, though, it means abandoning most of Consumer Demand 1971 and all of Variety, Equity & Efficiency (1979) and stopping at the paradigm cases, and perhaps earlier.

ASSUMPTIONS ON PREFERENCES

Lancaster's assumptions on demand are absolutely fundamental to his theory. All his analysis from the very beginning depends on his assumptions on the shapes of indifference curves in characteristics space. He takes a set of assumptions on consumer preferences which "simply carry over traditional preference theory, applying it to collections of characteristics instead of to collections of goods" (1971, p.20) in order "that the consumer's preferences can be expressed in the terms of an ordinal utility function of the neoclassical kind with all its first order partial derivatives positive" (1971, p.21). He assumes transitivity, completeness, continuity, strict convexity, non-satiation and all characteristics positively desired, in order to produce an indifference curve in characteristics space similar in shape to the indifference curve for goods which is to be found in elementary text books. In effect, he is assuming that people always get more satisfaction if they consume more of a characteristic. The implication is that these indifference curves are as good an approximation to reality as indifference curves for goods.

A fundamental error made here arises from the failure to recognize that the quality characteristics are never consumed one by one, as goods are, but are necessarily consumed together with other characteristics. Indeed, with Lancaster's assumptions they are all consumed simultaneously even if they come from different goods. This means that an analysis that can be used for two products, milk and manure, consumed separately, cannot be used for a single product, a mixture of milk and

manure, where the two are characteristics which are necessarily consumed together.

Lancaster's model assumes non-satiation.[30] Satiation can be important in several forms: satiation from too much of one characteristic in a good, satiation from combinable goods, satiation with non-combinable goods, satiation by concentrating goods, for instance. Some of these forms of satiation are relevant for all goods.

If we assume that two characteristics are consumed together and valued separately we will normally get indifference curves very different to those assumed by Lancaster. Extreme assumptions are necessary to get the shapes he assumes - for example all characteristics having positive but declining utility, going down to zero marginal utility for most of the curve.

With the more realistic situation where the satisfaction from one characteristic is in some way affected by the amount of other characteristics consumed at the same time, it is possible to get a wide range of shapes of indifference curve. Most of these are quite different from those postulated by Lancaster e.g. bull's eye, the paraffin/milk example, curves with multiple peaks and so on. In virtually all real-world products, there are some characteristics which are totally unacceptable, or unacceptable above a certain quantity - salmonella content, for instance - which means that for some dimensions at least, curves like the paraffin/milk one will exist. It is unlikely in the extreme that any one individual, much less most individuals in a market, will have Lancaster-type indifference curves on all dimensions.

Even if some individual did have such an indifference surface, there is no way we could show this to be the case, or identify the individual, so even there the theory is unusable.

These weaknesses in the assumptions on consumer preference mean that the theory has no application in real-world economics, or indeed in other practical applications.

SUPPLY SIDE ASSUMPTIONS

The second set of fundamental assumptions cover the supply side, and these are examined in Chapter Six of the refutation. The assumption is that at equilibrium it always costs more to get more of a characteristic (again an assumption that is widely used in theories with very different boundary assumptions). The assumption determines budget lines, efficiency frontiers and so on, and again Lancaster's

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[30] There is in fact a brief discussion in Consumer Demand of the possibility of satiation in the form of too much of a characteristic in total consumption arising from the increased income. This is of little interest compared with other forms of satiation. It is not incorporated into the theory.

analysis cannot start without this, much less develop beyond the paradigm cases.

Again, the assumption has been carried over from the economics of goods, where it is reasonable to assume that one must normally pay more to get more of a good. Again, it has been forgotten that the characteristics of a good are not bought separately and it is not possible to buy or consume one of a good's characteristics without buying and consuming some others.

The first reason for challenging this assumption is that there are many cases where the price of a product is not positively related to the level of the objective characteristics it contains. It is not surprising that for products where preferences form a bull's eye, prices will also form a bull's eye for instance, merely because at market level both demand and supply will tend to be concentrated on the most popular qualities.

The second reason for challenging the assumption is that it has no logical basis. In Lancaster Four, an attempt is made to justify the assumption, by assuming that production costs will make it more expensive to produce a good with more of a characteristic. However, Chapter Six shows that there are both marketing reasons and cost-of-production reasons for rejecting this argument.

Most agricultural markets are price taking markets, and in these markets the relationship between the cost of production and the price the marginal customer has to pay is indirect at best. In price-making markets a more direct link may exist, but the relation between costs and prices is obscure, in fact and in theory.

The cost of production argument, again, does not square with Lancaster's assumptions. With ingredient goods, the ones that appear to fit Lancaster's assumptions best, the actual Unit Product Differentiation Curve bears no relation to that postulated by Lancaster. With component goods, another type of good where level of characteristic might be related to cost, Lancaster Four's assumptions on economies of scale may not hold. For those goods where output characteristics are not the same as input characteristics, there is no reason to suppose positively priced characteristics or economies of scale.

It must also be recognized that consumers, producers and distributors have different concepts of quality, so that characteristics that are expensive to include may be of great importance to retailers but of little interest to consumers. For example, a retailer may be concerned with characteristics of the product line as a whole, like speed of turnover, waste, promptness of delivery and reliability. These may influence the cost of primary production, but they are invisible to the final buyer.

The fact that Lancaster's supply assumptions do not hold in most real-world markets also limits the application of his theory. They are essential for his budget lines and efficiency frontier which, in turn, are essential for his maximizing procedure and

consumer choice.

Taken together with the weaknesses of the assumptions on consumer preference, these weaknesses are overwhelming. It is not necessary to know the maximum quantity of characteristics a consumer can buy when he or she is clearly not attempting to maximize the quantity of characteristics consumed. It is of little interest to know that you can buy vast quantities of very acid, very sweet wine for your money if you much prefer the more expensive medium sweet, medium acid wine. The combination of the characteristics that may well be negatively priced and the indifference curves developed in Chapter Five means that none of the optimizing procedures Lancaster uses are meaningful.

ASSUMPTIONS ON OBJECTIVE CHARACTERISTICS

A major attraction of Lancaster's theory is that it works with "hard" data, with objective characteristics. It is designed to be completely independent of factors like different preferences, end use, perceptions, beliefs and emotions. They can be ignored in an analysis which examines only objective characteristics, and predicts only quantity sold. This appeals both to economists who prefer a hard approach and to researchers who are looking for an approach which does not require the heavy expenditure of determining beliefs and perceptions.

Lancaster's theory can only work with objective characteristics. It may be possible to plot a single individual's preferences against attributes using other approaches but not to determine from this how his or her choice would be changed by new levels of characteristics. Since the axes are then subjective, it is no longer possible to put two individual's preferences on the same diagram or to aggregate:

> "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 properties of goods" (Lancaster,
> 1971, p.6).

Lancaster can use the objective characteristic approach purely because he has assumed that characteristics are objectively measurable, that there is perfect knowledge, that consumers value the product for its characteristics and that consumers act in accordance with their preferences. By assumption, in fact, characteristics are the same as attributes. These may be termed fundamental assumptions on characteristics, but it might be argued that they were boundary assumptions.

In reality, of course, knowledge, perception, belief and the relationship between what consumers perceive to be the best action and what they actually do, are all imperfect - a fact that is recognized and is fundamental to other approaches like the

behavioural approach, information economics and marketing economics. Possibly products do exist where Lancaster's assumptions are a reasonable approximation, but they are not the norm.

A product has a large number of characteristics, and even a detailed product specification is a major simplification. In practice consumers can and will handle only a limited amount of information, and it may be that most consumer decisions are based on fewer than nine attributes. In practice attributes rather than characteristics are used, and the attributes are often constructed by bundling other attributes into mega-attributes like comfort, power, safety, taste and beauty. End use, perception, emotion and belief play a large part in determining what the mega-attributes are and how goods are evaluated in respect to them. This is recognized by approaches like marketing and behavioural approaches which have developed techniques to deal with these, rather than assuming them away.

Once it is recognized that there are differences between subjective and objective, it is no longer possible to lump together all the difficulties of end use, perception emotion and belief, and keep them separate from objective characteristics as Lancaster does.

FLAWS IN LOGIC

Fundamental flaws in logic cast doubt on the theory as a whole. Two may be mentioned here: first the problem of identifying real situations where the assumptions hold and second the problem of characteristics space.

Identifying where the assumptions hold

Lancaster's model can only be expected to work where its assumptions apply - he is emphatic that it does not apply in all instances. Logically, however, this means that the theory cannot be applied unless we can state that the assumptions hold in the particular instance we are examining. It would be totally incorrect to apply the theory at random, and say that the assumptions must have applied in any case where the predictions were not wildly inaccurate.

It was shown in Chapter Five that there were strong grounds for believing that cases where Lancaster's assumptions on preferences were correct would be extremely rare in practice. This means, at best, that the theory is of very limited application. However, in Chapter Eight it is shown that it is not possible to observe the indifference surface of a single individual, much less those of most individuals in a market. It is not possible, therefore, to say that the fundamental assumptions of Lancaster's theory apply in any one situation, so the theory should give testable predictions there. The theory is not operational.

The difficulties of identifying an individual's preference functions are discussed in Chapter Eight. It is shown that even when there is perfect information and characteristics are known, it is not possible to plot indifference curves by observing what a consumer purchases. The observer does not know which of many possible characteristics spaces to plot the purchases in. There are insufficient observations to plot a two dimensional curve, let alone an n-dimensional surface. With large purchases like a house, there is necessarily only one purchase, and it may not lie on a budget line. Changing prices, preferences, budgets and prices of substitutes limit the number of observations. Quantity purchased may vary as well as the characteristics mix. Observing this brings in considerations of purchase over time and observation of purchases over time (Lancaster assumed away time in a <u>ceteris paribus</u> assumption which was never dropped). Such problems arise, less powerfully, with identifying the indifference curves of goods in traditional theory, and they arise sufficiently often that indifference curves are seldom used in practical work. However, it is argued here that (a) there is a very high probability that indifference curves do not conform to Lancaster's assumptions, (b) there is no way of identifying cases where they do conform, and (c) the theory only applies where they do.

In Chapter Eight it is also shown that there are other possibilities compatible with a perfect knowledge assumption which make plotting surfaces difficult. For example, consumers with very different attributes derived from the same, accurately-observed characteristic, consumers' perceptions of what is fashionable, attributes related to two or more characteristics, or a single characteristic contributing two or more attributes.

The analysis is different depending on whether one is dealing with indifference curves (utility contours) or iso-preference curves (what people actually buy). Lancaster neither drops his initial assumption that the two are the same, nor decides which he would use if he dropped the assumption.

Characteristics Space

Lancaster's use of what he calls "characteristics space" is, at first sight, attractive. The axes of his diagrams are labelled "Characteristic A" and "Characteristic B" in Lancaster (1979) and (in effect) "Level of Characteristic A" or "Level of Characteristic B" in Lancaster (1971). However, this simplicity is deceptive. Initially, his axes appear to refer to "total amount of characteristic in total consumption" (with his assumption of instantaneous consumption) but at other times it appears to be "Total amount of characteristic in diet" "Level of characteristic in an automobile" "Level of characteristic obtained from purchases of this group of goods" and so on. Since the shape of both the indifference curve and the product possibility curve or budget line depends on the axes used, there is constant confusion throughout the analysis.

This confusion is a serious flaw in the logic. The same failure to see the effects of different characteristics spaces is to be found in most other approaches.

CONCLUSIONS

It is concluded, therefore, that Lancaster's theory of consumer demand has the following limitations:
1.   Its boundary assumptions are so restrictive that it can have little application in the real world.
2.   Its many ad hoc assumptions mean that the full theory almost certainly has no practical application.
3.   Even if a situation existed where the ad hoc assumptions did apply, there would be no way of identifying that situation.
4.   The fundamental assumptions on consumer preference are unrealistic in most cases.
5.   If by chance the fundamental assumptions on consumer preference did hold in any case, it would not be possible to identify this case.
6.   The fundamental assumptions on supply price are usually unrealistic.
7.   The fundamental assumptions on subjective or objective quality seldom apply.
8.   There are fundamental logical problems.
9.   The theory has not been tested.

Any of these limitations casts doubt on the validity of using the theory in real-world economics applications: at best the theory would apply in so few cases that it is of little interest. The cumulative effect of the limitations is to discredit the use of the theory in real-world economics. However, since the criticisms apply at a very basic level, all except the criticism of ad hoc assumptions applying before the paradigm cases are established, the use of the theory for any practical purposes in relation to other products or markets is equally suspect.

WHY HAS LANCASTER SURVIVED?

Why has Lancaster's theory survived and continued to dominate the economics of quality if it has so many limitations? The answer appears to lie in the testing it has been subjected to, to the attractions of the theory, to the limited attractions of alternative theories and to the sociology of knowledge.

TESTING THE PREDICTIONS

One reason it has survived is that it has not been possible to test the predictions of the theory directly. Any indirect tests appear not to have been crucial, but rather to have been of the nature of "which model gives the best fit?" Inevitably, for the reasons given above, models based on Lancaster will sometimes give the best fit on some occasions, even if his theory is inapplicable in that situation. Inevitably, too, reasons can be found for ignoring the inconvenient results when models using Lancaster gave poor results, for example it might be said "Lancaster's theory was right, the model was wrong", "The assumptions did not hold here", "The data was obviously wrong", or "The aggregation was clearly incorrect".

The basic assumptions of Lancaster's model are not so very different from those of alternative micro-economic approaches, and the derived model may approximate to hedonic approaches, so it would be surprising if there were consistently large differences in the predictions. Often the models described as being based on Lancaster were not. Indeed Lancaster complains:

> "Economic models are ill-served by a precipitous rush (especially by thesis-hungry graduate students) to "measure" or "test" the models in a crude formulation and with inappropriate data. To the extent that the model builder fails to provide operational guidance, he has only himself to blame if empirical work, purportedly related to the original model, dissolves into a set of regression equations in which the original model is unrecognizable, or in which the discrimination between his and a dozen other models has been lost in simplification or linearization" (Lancaster, 1971, pp.113-4).

Put another way, one may question how many of the analyses purportedly using Lancaster, were for instance, straight hedonic analyses little different from Waugh (1928), used in situations where none of Lancaster's assumptions applied. Some users appear to believe that the distinguishing mark of Lancaster's work is its characteristics approach, and that anything taking characteristics into account is "Lancaster's characteristics approach".

One implication of this is that if a model citing Lancaster proved reasonably accurate, it may have been taken as support for the Lancaster theory even if the model was not consistent with the theory.

The tests have not examined whether the assumed indifference surfaces were correct, because of insuperable problems in measuring these.

TESTING THE THEORY

The tests of Lancaster's theory presented here are new and will have had no effect on the acceptance of his theory in the past.

Previous criticisms have largely been criticisms of the limited applicability of Lancaster because of his stated boundary conditions. These have been almost entirely ignored by the people who continue to use Lancaster. They are cited by only 1.5% of the people who have cited Lancaster in recent years. It may be that people with a background in real-world economics, marketing economics, marketing or psychology moved to their own preferred approaches, rather than citing him or criticizing him. The reaction is likely to have been to ignore him rather than to test his theory.

To many economists the criticisms of what are here called the boundary assumptions here were not convincing. This may have been because they saw the criticisms as being criticisms of those simplifying assumptions which every theory must make, not appreciating that the theory just does not work without these boundary assumptions (and to be fair, this point was not made by the critics). They may have assumed that, as with simplifying or ceteris paribus assumptions, one can often make predictions where the assumptions do not hold exactly. Some economists appear to have read the assumptions as being Lancaster's belief on how consumers actually behave, and to have taken the criticisms as being merely a statement that there will be occasional exceptions. Lancaster has encouraged this confusion: while he is often totally rigorous about where his theory does and does not apply, often he is not, most noticeably in the concluding chapters of Variety, Equity and Efficiency, where he draws very broad conclusions about situations where none of his assumptions apply.

The few purely logical criticisms in the literature carried little weight -they do not appear to have been replied to or incorporated into the paradigm. They are, however, irrelevant to the criticisms presented in this refutation, as they apply to later parts of Lancaster's theory.

THE ATTRACTIONS OF LANCASTER'S THEORY

Another reason why Lancaster's theory has survived is that it has attractions which some other theories do not have.

-        It has an obvious rigour of analysis which inspires confidence and suggests that alternatives may, perhaps, be a little slapdash.

-        It is presented at length, as an integrated model.

-        It makes use of theory which is familiar from other contexts, like

indifference curves, giving the reader confidence that he or she already understands the logic of the argument and that it is in any case basic economic theory that everyone is agreed on.

-       The use of characteristics and the exclusion from consideration of emotion and perception simplifies the analysis and appeals to those economists who prefer to deal with hard data (myself included). It also appeals to those economists and marketing professionals whose job requires them to make recommendations in terms of physical changes in production specifications, rather than, say, advertising campaigns. It is much cheaper to do research in terms of objective characteristics than it is in terms of perceptions, beliefs and emotions.

-       The fact that Lancaster makes larger claims for his theory, in Variety, Equity and Efficiency and in papers like Lancaster (1990) adds to his attractions.

LIMITED ATTRACTIONS OF RIVAL APPROACHES

Another reason Lancaster has survived is that rival approaches have limited attractions. The closely-related economic-man theories, for example, share many of the same assumptions; they are no more susceptible to direct or indirect testing of predictions, they are in general less impressive than Lancaster's.

Some other approaches, behavioural, psychological and sociological approaches in particular, and marketing approaches generally may not appeal to economists who get pleasure from arguing theory rigorously from first principles.

Other theories like the hedonic approach have considerable intuitive attraction as being an obvious way of tackling the problem, but on examination it becomes clear that there are a great many unanswered questions about why they should work, so they do not appeal to economists who require formal rigour in a model based on economic man. In fact one reason why Rosen (1974) and Lancaster were so popular is that they could be read as giving a legitimacy to the hedonic approach.

THE VALUE OF THIS REFUTATION

This refutation examines Lancaster in terms of the value of his theory for practical real-world economics. The refutation itself must be judged in the same terms: does it produce results which will help real-world economists?

The arguments and conclusions set out in this refutation are original. They identify serious limitations in the dominant economics approach to quality. Lancaster's is far

and away the most cited in the literature on the economics of quality and is widely used in marketing. It also appears in many textbooks as a standard approach. The criticisms have been directed at Lancaster both because of his dominance and because of the rigour of his approach, but they apply to those parts of other theory which share his assumptions or his logic.

The first result is to show that Lancaster's theory is of no practical application. This is a negative result but an extremely important one. It means that economists can in the future concentrate on other approaches that may be more practically useful. The effect of this should not be underestimated. It seems likely that more than two thousand economist-years have gone into academic research based on Lancaster. The amount of time spent by real-world economists, business economists and market researchers on models using his theory cannot be estimated. The amount of time spent by lecturers teaching the theory and students learning it should also be taken into account. Had this effort been spent on developing some of the other approaches, the subject would be far more advanced than it is.

The approach to testing theory is itself useful, drawing attention away from fruitless attempts to test the theory by examination of the predictions of models based on it. The classification of different types of assumption and the testing of assumptions and logic provides a framework which can be used for testing alternative theories, so that development can be concentrated on the more promising approaches.

The new theory developed here on indifference curves, supply, subjectivity and characteristics space has a practical value of its own. It is clearly applicable in its own right, and its value does not depend on the force of the criticisms of Lancaster.

The theory can be incorporated into many of the approaches used today. It may not be possible to incorporate it into economic man approaches, where this would involve reworking the analysis from the beginning, as with Lancaster. It is clearly not incompatible with hedonic approaches for instance, though it would involve great care in drawing up specifications. Similarly, with psychological approaches it requires greater care in asking the questions and interpreting the answers, rather than abandoning the theory and the effect should be improved prediction. Logical errors at the later stages of Lancaster's analysis probably exist but are of little moment. It is easy enough to replace wrong logic at this stage, changing the conclusions a little perhaps, but not altering the fundamental theory. This later part of the analysis is of little interest anyway, because it is based on so many ad hoc assumptions.

The theory makes it possible to provide much more realistic specifications when modelling supply and demand of characteristics than the simple linear or log-linear curves often used. Similarly the perception that utility depends on the relationship between characteristics and, in a rather different way, the relation between attributes, will increase accuracy. It will also mean that investigators ask the right questions,

not formulating them in such a way that the answers must conform to a linear response.

Investigators who continue to work as before may in future be asked why they did not consider the possibility of the relationships between characteristics, utility and price set out here.

FUTURE RESEARCH

The analysis presented here can be the basis for future research, both conjecture and refutation.

Refutation of existing theories is urgently needed in a subject that is increasingly cluttered up with new and untested theories. If the non-starters can be removed, and the limitations of others can be clearly set out, it becomes possible to build up new and powerful theory based on assumptions that are widely believed to be reasonable. Refutation also give new insights which can be built into the new theory.

The testing procedure that has been applied here to Lancaster can be applied to other theories. With the economic-man theories that are closely related to Lancaster, the main problem will be that their assumptions are not set out so clearly and rigorously. The more distant theories, such as behavioral theories, share some of the assumptions, not others. The implications are less clear cut, but it is to be expected that significant adjustments to the theory will be required.

The testing has shown that there are major problems in trying to build up models from economic man, or trying to build quality into "consumption theory" and suggests that it will be worthwhile to try other approaches.

The analysis provides insights which will improve the effectiveness of individual-based approaches like the behavioral or psychological. The more realistic shapes used for indifference curves offer the possibility of better statistical fits in quantitative research. The use of Computer-Aided Design software for modelling n-dimensional surfaces could give new insights.

The most interesting question for future research is for psychologists and specialists in the sociology of knowledge. They should ask why a science firmly committed to Popper's falsification or at least to verification and to the view that their science is of practical value, should have given a dominant place to a theory

-          Which has never been tested.

-          Whose boundary assumptions rule out most of reality.

-      Whose <u>ad hoc</u> and <u>ceteris paribus</u> assumptions rule out everything else.

-      Whose fundamental assumptions on preferences, prices and objectivity were clearly unrealistic.

-      Whose assumptions could not be shown to apply to any real life situation.

-      Whose logic was wrong.

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