HIERARCHICAL CHOICE IN ECONOMICS

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Abstract. The paper examines the relevance for economic issues of choice which is not characterized by unlimited substitutability. After showing that hierarchical choice is common in other social sciences like psychology, the paper proceeds with an examination of such choice and of its different categories. Subsequently the implications for hierarchical choice for specific economic issues are analysed. In particular, there is discussion and literature review of demand theory, Engel curves, the theory of the firm and social choice theory. Finally, some suggestions for the application to other economic problems are considered.

Keywords. Hierarchical; Choice; Preferences; Needs; Microeconomics.

1. Introduction

Many economists believe that behaviour characterized by unlimited substitutability is a universal, obvious and logical idea. It is assumed that all preferences can be substituted, or in terms of utility theory, that economic agents compare and reduce everything to a common denominator: utility. In consumer theory for example, complete substitutability of every good is assumed in the sense that a loss of some units of one bundle can always be compensated by gain of some unit of another commodity. In formal terms, preferences are usually assumed to be as follows. Suppose that there are two bundles of goods x and x' and that

$$(x_1, x_2)P(x_1', x_2')$$

this can be reversed by increasing x_1' which implies that there exists $x' > x_1'$ such that

$$(x_1', x_2')P(x_1, x_2)$$

Usually such preferences are called Archimedian Borch (1968).

No doubt the idea of complete substitutability is relevant in many spheres of economic activity and has proved to be extremely useful for a great number of theoretical formulations. However, there are situations where the assumption of unlimited substitutability seems to be weak, irrelevant and at times misleading. As we shall see there are many examples in economics where limited substitutability or a hierarchical type of behaviour seems more appropriate. In many cases, preferences are of varying importance and thus it may not be possible to substitute fully. The idea of behaviour based on strict or loose hierarchy is common in psychology, politics and sociology (see Maslow 1954, Tversky 1969, Ardrey 1970, Prelec 1982, Margolis 1982), but it is quite relevant to a large variety of economic phenomena too. Moreover, unlimited preference

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substitutability can be seen as a special case of a general hierarchical type of behaviour.

The concept of hierarchical behaviour is not alien to economic thought and in fact a number of influential theorists have from time to time written about the idea. However, it seems that it did not have a significant impact. In particular, Marshall's reference to the idea in his 'Principles' did not result in a wider appreciation of its possible usefulness (Marshall, 1949, pp. 56–58; Endres,1991). Other theorists like Menger (1950), Georgescu-Roegen (1966) and Little (1957), were sympathetic. However, for one reason or another the dominant body of economic theorists has ignored this interesting possibility and thought of unlimited substitutability as a universal phenomenon. Nevertheless, work on hierarchical choice has been undertaken, and might be seen as a possible solution or provide new insight to a considerable number of economic issues. It can be applied to a wide variety of economic problems ranging from consumer theory, demand theory, aggregate expenditure, and social choice theory to the theory of the firm.

This survey starts with an examination of hierarchical choice and of its different categories. Subsequently, the implications of hierarchical choice for specific economic issues are examined. In particular, there is a discussion and literature review of consumer and demand theory, Engel curves, social choice theory and the theory of the firm. Finally, some suggestions for the application to other economic issues are considered.

2. Categories of hierarchical choice

The idea that preferences, wants or needs might be structured in a hierarchical manner is an old one and can be found in philosophical writings as old as Plato. In his 'Republic' for instance Plato states:

> But the first and greatest of our needs is the provision of food to support existence and life... The second the provision of a dwelling-place, and the third of clothing, and so on. (Plato Republic, II, 369).

It can also be found in various passages in the history of economic thought. There are scattered examples in the work of Jevons (1924, p. 44) and especially Menger (1950, pp. 122–133) and also in that of subsequent theorists. Specifically, Menger attempts to explain utility in terms of a set of preferences in declining order of importance. For example, in the case of a farmer his first priority is to provide food for self, second for family, third for next year and so on (Menger,1959, pp. 122–33). Moreover, Marshall in his 'Principles', gives some clear indications that wants might be of varying importance and thus irreducible. He states:

> It is common to distinguish necessaries, comforts and luxuries; the first class including all things required to meet wants which must be satisfied, while the

> latter consist of things that meet wants of a less urgent character. (Marshall, 1949, p. 56).

It is clear that Marshall was implying a hierarchical structure of wants or needs in the above quotation (for additional evidence see Endres, 1991, pp. 336–38). Wants that 'must be satisfied' are obviously basic wants which can not be substituted for wants of 'less urgent character'. Also it should be pointed out here that Marshall also implied that some goods satisfy a number of different needs. (Similar ideas on this respect can be found in Lancaster, 1971).

More recently, Little (1957) and Georgescu-Roegen (1966 originally 1954) have devoted some time and space to the issues. Little devizes a system of choice where there are two different criteria: Life Principle implying basic wants and Pleasure Principle implying not basic wants. The Life Principle criterion operates first. The resulting curves are called behaviour lines (One can note here that there is scope of connecting Little's ideas with subsequent work on 'split personality'. The split personality literature sees agents as making decisions on the basis of two different criteria, Elster, 1985; Thaler and Shefrin, 1981; Margolis, 1982).

Georgescu-Roegen theorises about an economic agent who has a hierarchy of wants. Wants which relate to basic needs come first and those which relate to secondary needs come second. Subsequently other theorists like Encarnaciòn (1964), Banerjee (1964), Ferguson (1965), Gorman (1971), Chipman (1971), Ironmonger (1972), Day and Robinson (1973), Fishburn (1974), Arrous, (1978) and Lancaster (1991 originally 1977) have elaborated the idea of a hierarchical behaviour in terms of choice theory. Robinson (1956), Kornai (1971), Lutz and Lux (1979), (1988) Canterbery (1979), Pasinetti (1981), Earl (1983), (1986), Schefold (1985) and Eichner (1987), have all attempted to link the issue with alternative approaches to economics.

Before proceeding further we should make a distinction between the terms 'needs' and 'wants'. It is quite easy to perceive the terms as essentially equivalent. However, there is a difference which is important especially in relation to hierarchical behaviour. A need implies something that it is universally necessary, for instance the need to eat. Although there is dispute about whether or not some needs 'naturally' exist, it has been suggested that needs should be regarded as universalisable in the sense that under the same circumstances they are common to all humans (Doyal and Gough, 1984; Baxter, 1988). On the contrary, the term want implies a personal preference which is a trait of the individual (obviously a want might or might not satisfy a need). The distinction is important because the standard approach which is characterized by complete substitutability operates mainly in terms of wants. (For a further discussion of the importance of the distinction see Baxter, 1988, pp. 32–42.) Since wants are a personal inclination, it is easier to think in terms of substitution, while the universal character of needs implies that there is only limited room for need substitution (Georgescu-Roegen, 1966, Lutz and Lux, 1979).

First type: lexicographic

As was mentioned earlier, the concept of hierarchical behaviour has been relatively neglected by the large body of economic theorists. The closest approach in economic theory texts is the idea of lexicographic choice which is a very limited variation of hierarchical behaviour. This formulation implies that there is an absolute order of preferences and thus precludes any degree of substitution. The theoretical formulation in terms of preferences of this simple version is: Let x and x' be two alternatives which might be bundles of goods or business objectives

$$x = (x_1, x_2, \ldots x_n)$$

$$x' = (x_1', x_2', \ldots x_n')$$

$$xPx' \text{ iff}$$

either 1) $x_1 > x_1'$

or 2) $x_1 = x_1'; x_2 > x_2'$

or 3) $x_1 = x_1'; x_2 = x_2'; x_3 > x_3'$

$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$

$$x_{n-1} = x_{n-1}'; x_n > x_n'$$

The key point here is that the components of each vector are not viewed as equally important. Component x_1 is considered as absolutely important. Only when there is equality in terms of x_1 is there room for the comparison of the second component in importance. In a regular ordering, all the components are equally important.

In order to express this in utility terms, u is assumed to be a preference index function or stated differently, utility is represented as a components-ordered vector. (In the case of consumer theory x would be a point in the consumer's commodity space, and it is assumed that there is a sequence of real-valued functions $u_1(x)$, $u_2(x)\ldots$, whose values u_1, u_2, are coordinates, of a point u in the consumer's utility space thus implying a mapping of the commodity space into the utility space, see Canterbery, 1979, p. 87 and Encarnaciòn, 1964a). Then

$$u(x) > u(x') \text{ iff}$$

either 1) $x_1 > x_1'$

or 2) $x_1 = x_1', x_2 > x_2'$

Again choice here is based on the first element which implies that its utility is equal to infinity. (For a technical discussion of lexicographic utility see Day and Robinson, 1973 and Fishburn, 1974).

Someone could argue that the Neoclassical analysis in terms of corner solutions is similar to the above. The similarity though is superficial since a corner solution still implies full substitutability: the agent is willing to give up more of the first good for additional quantities of the second good, but his

constraint is that there are no quantities of the second good left. Lexicographic choice implies that there is no substitution between the two.

The classic textbook example of lexicographic behaviour is related to addiction such as alcohol (dipsomaniac). Many authors dismiss this kind of behaviour as exceptional and non-applicable, although they would not deny that it is rational and consistent (Malinvaud, 1972, Deaton and Muellbauer, 1980, p. 27). There is a justification for this approach in the sense that the essence of many economic situations is trade which involves substitution. However, this extreme case of hierarchical behaviour is not totally irrelevant if one is willing to accept the importance of custom, habit and belief in certain economic situations (Veblen, 1899; Arrows, 1987, Hodgson, 1988; Nelson and Winter, 1982). For instance, vegetarians are characterized by lexicographic preferences: no substitution between meat and vegetables. Non-smokers provide another good example.

Before we close this section, it has to be noted that another reason for the relevance of lexicographic and in general of hierarchical approach is its appropriateness in coping with complexity. In particular, many of the authors who advocate hierarchical choice see the decision-makers as engaging in hierarchical behaviour as a means to find workable rules for coping with the complexity of the world (see Earl, 1983, 1986).

Second type: target setting

The strict lexicographic case (the extreme model) is only one of the possible variations in hierarchical behaviour (Earl has specifically stressed that the lexicographic case is only one of the possibilities, Earl, 1986, ch. 9). It is possible to formulate hierarchical behaviour which allows for a considerable degree of substitution. This involves the setting of targets in the sense that agents must reach a target (or threshold) of the first component before starting to consider the next most important one. In the case of consumer theory for instance, the individual needs to consume a certain quantity of a given commodity before starting to consume other commodities. The formulation of this behaviour is the following: (x_i^* is the necessary level in this case).

$$x = (x_1, x_2, \ldots x_n)$$

$$x' = (x_1', x_2', \ldots x_n')$$

$$xPx' \text{ iff}$$

either 1) $x_1^* > x_1 > x_1'$

or 2) $x_1 = x_1' < x_1'^*; x_2 > x_2'$

or 3) $x_1' < x_1^* < x_1$

or 4) $x_1^* < x_1, x_1'; x_2^* > x_2 > x_2';$

$$\vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots \quad \vdots$$

$$x_{n-1}^* < x_{n-1}, x_{n-1}'; x_n' < x_n$$

It must be pointed that we can have minimum acceptable levels for the other elements of the vectors, i.e. x_2^*, x_3^*. In utility language the main difference of target setting from lexicography is that the utility of the first element here is less than infinity.

We can also introduce a variation of hierarchical behaviour with an even higher degree of substitutability. For instance in the case of consumer choice one can assume that there is a minimum consumption level that can actually combine both goods. Thus the minimum acceptable level e^* might involve a combination of both commodities and this implies substitution between them as far as the first need is concerned. For example if x_1 and x_2 represent food and they both satisfy the first need which is to eat then $x_1 + x_2 = e$. But if x_2 satisfies better the second need which is assumed to be taste, then we have a hierarchical type behaviour but with a considerable degree of substitutability (see Georgescu-Roegen, 1966, Day, 1971, and Drakopoulos, 1992).

The theoretical formulation of the above ideas is the following:

$$x = (x_1, x_2)$$

$$x' = (x_1', x_2')$$

$$xPx' \text{ iff}$$

either 1) $x_1' + x_2' < x_1 + x_2 < e^*$

or 2) $x_1' + x_2' = x_1 + x_2 \leqslant e^*; x_2' < x_2$

or 3) $x_1' + x_2' < e^* < x_1 + x_2$

or 4) $e^* < x_1 + x_2; x_1' + x_2'; x_2' < x_2 < x_2^*$

The incorporation of a considerable degree of substitutability, without losing the essence of that behaviour which is hierarchical, greatly enriches its relevance for economics. As a final point, it should be noted that hierarchical choice need not to be linear as most authors conceive it. There is the possibility of having a tree structured hierarchy as was suggested by Strotz (1957).

Habits and hierarchy

It is not hard to see that the existence of habits reinforce the relevance of hierarchy since they make complete preference substitution more difficult. Thus, before we finish this section, it is necessary to mention something about recent work on habitual behaviour with a hierarchical flavour. (Most of this work though is not explicitly concerned with the formulation of hierarchy in the manner that we have seen above, mainly because the incorporation of habits is the main interest.) In particular, the aim is to construct habitual behaviour in consumer theory on the basis of the concept of 'minimum necessary quantities of goods'. The starting point is that there are some necessary goods $(b_1, \ldots, b_n)$ and some non-necessary ones $(a, \ldots, a_n)$. The agent's income after 'necessary'

consumption is:

$$\mu - \Sigma\, b_k p_k$$

Habits are usually brought into the picture by assuming that the necessary quantity of each good is proportional to consumption of that good in the previous period:

$$b_{it} = \beta_i x_{it-1} \qquad 0 \leqslant \beta < 1$$

where b_{it} is the value of b_i at period t, x is the level of consumption of the ith good in period t and β_i is the habit formation coefficient. Generally it is also assumed that the necessary quantity of each good is a linear function of consumption of that good in the previous period:

$$b_{it} = b_i^* + \beta_i x_{it-1} \qquad 0 \leqslant \beta_i < 1$$

The interpretation is that b_i^* is a 'physiologically necessary' component of b_{it} and $\beta_i x_{it-1}$ is the 'psychologically necessary' component. There is some econometric work which supports the theoretical formulations (see for instance, Blanciforti and Green, 1983).

The above approach is followed by a number of theorists such as Gorman (1967), Pollak (1970), Blanciforti and Green (1983), Spinnewijn (1981), Alessie and Karteyn, (1991). As will be seen in a subsequent section, this approach is also similar to Stone's linear expenditure systems. It must be noted that although there is a hierarchical element in the construction, the emphasis is on the aspect of the habit formation.

3. Some implications for economic analysis

Goods, needs and demand curves

The idea of hierarchical behaviour, especially in relation to consumer choice, is vitally connected to the types of goods. It also relates to the distinction between needs and wants. The connection is that some needs are satisfied by a large variety of goods while other needs can only be satisfied by a limited number of goods. It is possible to think of bundles of goods which correspond to a particular need. For instance, the need to eat can be satisfied by a large category of goods which can be classified as a food bundle. It is easy to see that there must be considerable substitution among the elements of this bundle. However, there is limited substitution when there is a comparison of this bundle with the bundle which satisfies the need for shelter (which is satisfied by a much narrower bundle). In general, it seems that hierarchical behaviour is more relevant when the bundles of goods are defined so as to refer to categories of needs (i.e. food products satisfy the need to eat) (Ironmonger, 1972, Earl, 1983, 1986).

Also in the same way it is safe to say that regardless of classification into bundles, some goods do not satisfy certain needs (i.e. cinema tickets cannot satisfy the need to drink regardless of their bundle classification), while others

may satisfy more than one need (e.g. wine can satisfy both the need to drink and a social need, see Encarnaciòn 1964a, Earl 1986, and Brooks and Earl 1987).

A change in thy budget constraint can actually have implications for which goods will be bought or substituted. The important point is that the need remains the same but the goods which satisfy this need will change in relation to the budget change (people find it easier to substitute goods that satisfy the same needs than to substitute needs, and this is the point of hierarchical behaviour). Having stated that, it is also important to point out again that there are some needs that can only be satisfied by a very limited number of goods.

In order to see the type of demand curve which is implied by the target setting category of hierarchical behaviour, let us assume that there is no income constraint and that x is a necessary bundle of goods (survival goods). The corresponding demand curve will be a vertical line up to x^* where the next need becomes important. After point x^*, there is a change in slope which reflects the change in the relative efficacy of x to satisfy the next need which might be entertainment needs (see Figure 1). Since there is no income constraint, the agent will reach x^*. Once the point x^* is reached, a fall of P will induce a higher consumption of x, but a part of income is now spent on other goods satisfying the next most important need. The fact that the demand curve contains a negatively sloped segment, implies that some basic goods can also satisfy entertainment needs. In terms of utility it is assumed that

$$\left.\frac{\partial u}{\partial x}\right]_{x > x^*} > 0$$

On the other hand if there is an income constraint which is less than the price of necessary goods (for high prices of x), the demand curve will be a rectangular hyperbola up to x^* and will become linear and negatively sloped after this point. This implies that the agent spends all income on good x up to x^* but after this

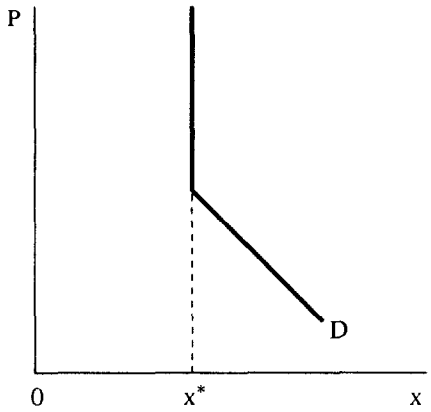

Figure 1.

level, a part of income is spent on other goods. Moreover, there is a case when the linear part might become vertical when:

$$\frac{\partial u}{\partial x}\Big]_{x > x^*} = 0$$

Basic goods are assumed to satisfy basic needs only.

The general case of the hierarchical model will be a kinked or a multi-kinked demand curve (not necessarily linear) with kinks representing the relative efficacy of goods in satisfying different needs (Earl 1983, 1986). The kinked demand curves derived from hierarchical preferences, might be seen as additional explanation for some macroeconomic problems such as price sluggishness (Drakopoulos, 1992, and for a general discussion of kinked demand curves, Reid, 1981).

Engel curves

The adoption of hierarchical behaviour also has important consequences for the construction of Engel curves. If we combine the above system of consumer choice with changes in income we can obtain a kinked Engel curve. It is also possible to show the quasi-indifference or behaviour lines according to Little which result from hierarchical behaviour. (Obviously the same construction can be used in the section dealing with demand curves.) Taking a simple example of x_1 representing bread and x_2 caviar, and as before the first need is the need to eat and the second need is for taste. Good x_1 satisfies better the first need (also represented with utility index u_1), and good x_2 satisfies better the second need (represented by a utility index u_2, see Encarnaciòn, 1964a; Day and Robinson, 1973, Canterbery, 1979).

In Figure 2, the steep curves represent behaviour curves of a preference

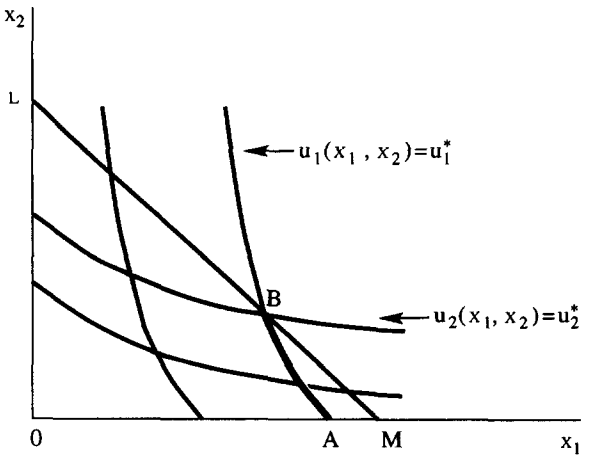

Figure 2.

ordering determined by the first and most important need. The slope of the curve indicates that good x_1 satisfies better the first need. This need is satisfied at level u_1^* when the next need becomes important. In the same way, the flat curves reflect the second need which is satisfied better by good x_2. As before, the target of the second need is satisfied at u_2^*. LM is the budget line. The heavy line is the income-consumption path. Initially, the agent spends all his income in buying bread up to a point when his need for food is satisfied and the need for taste comes into the picture. So at the first stage the income-consumption path coincides with the horizontal axis. Once u_1^* is reached the second need becomes more important and the flat curves become relevant. Thus the agent consumes both goods but the consumption of x_1 falls while the consumption of x_2 increases (Day and Robinson, 1973).

The resulting Engel curves will exhibit a kink where the first and most important need is satisfied and the second becomes important. In the case of good x_1 the Engel curve will be as indicated in Figure 3.

In Figure 3, the Engel curve exhibits a negative slope after the kink. The important point in general is that there is a change in the slope of the Engel curve which reflects the change in the capacity of the good to satisfy subsequent needs as income increases. This leads us to the issue of normal and inferior goods as well as to necessities and luxuries. The standard microeconomic indifference analysis has not much explanatory power when it comes to these issues. It only classifies goods according to the income and substitution effects. On the contrary, the hierarchical model offers a strong theoretical justification for the classification of goods. The difference in the analysis of the substitution effect between the two approaches is indicative. According to Earl (1983), p. 109, in the standard analysis a substitution effect arises if lowness of price within a budget range is a desired attribute; while in the hierarchical models, a substitution effect arises only if there are rival goods within the chooser's price

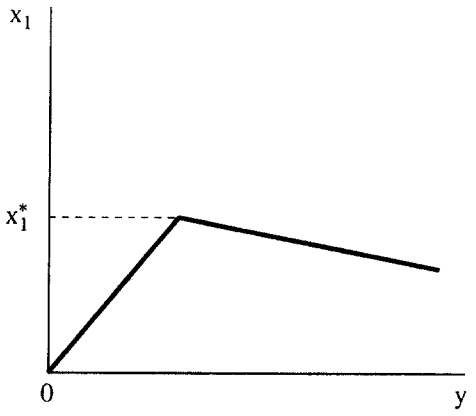

Figure 3.

range which seem to be at least satisfactory in all non-price dimensions left to be relevant. In addition, the hierarchical model provides a more realistic perspective towards the issue of luxuries versus necessities because it connects it with the idea of basic and non-basic needs.

Kinked Engel curves could be combined with applied research on the concept of the extended linear expenditure system (ELES). In particular, ELES is an indirect way of searching for manifestations of hierarchical behaviour at the aggregate level. The basic equation of the ELES formulation as has been specified by Lluch (1973), Lluch *et al.* (1977) and Canterbery (1979) is the following:

$$v_i = p_i a_i + b_i(y - \Sigma p_j a_j)$$

where $v_i = p_i x_i$ (p are prices and x are quantities), y is per capital disposable income, $v = \Sigma v_i$ is total expenditure, and savings (s) are $s = y - v$. Also a_i parameters represent basic needs, $\Sigma p_j a_j$ represent total subsistence or committed consumption. It has to be noted that the ELES approach has similarities with the well-known linear expenditure systems (LES) that can be found in Stone's (1954) work and Klein-Rubin (1947). (Moreover, there is a similarity with the habit formation studies and Almost Ideal Demand Systems — AIDS — that we saw previously.) The main difference between ELES and LES is that in ELES v is determined endogenously (Lluch *et al.*, 1977).

Usually the authors on ELES give it a microeconomic foundation in terms of utility theory (Lluch, 1973, Sato, 1972, Houthakker, 1960). The utility function which is implied here is directly additive of the form:

$$U(x) = \Sigma f_i(x_i)$$

One can note here that there is a difference from the target setting model in the sense that specific goods are assumed to satisfy only specific needs, and there is no possibility of the same goods satisfying different needs. In spite of this however, the important idea that some needs must be satisfied first, is common.

One implication of the hierarchical formulation above is that the expenditure for bundles of basic goods (e.g. food, clothing) should increase as the real income per capital rises but should fall as a share of total actual expenditure. This implies that as the basic needs are satisfied, consumers spend a higher proportion of their income on less necessary goods. Furthermore as income increases even further some of the less necessary goods should become cultural necessities (e.g. durables) and thus their budget share should also start to decline (Lluch *et al.*, 1977).

A number of empirical studies seem to substantiate this indirect manifestation of hierarchical behaviour. The econometric results have been estimated for different countries by using time series and cross section data. The findings demonstrate that subsistence expenditure on food falls from around 63 per cent at the per capital GNP interval of $100 to $500, to 50 per cent at higher levels (Lluch *et al.*, 1977 and Canterbery, 1979, p. 91).

Theory of the firm

If the assumption that the single goal of the firm is to maximize profits is dropped, there is the possibility of a number of objectives which can be represented by a firm's utility function. The work of Baumol (1969), (1962), Marris (1963) and Williamson (1964) which is known as managerial theories of the firm, provides ground for the application of hierarchical behaviour. Also behavioural theories such as Cyert and March (1963) are also prone to hierarchical analysis since they assume satisficing levels of variables. Moss' (1981) approach is a more recent example. His main assumption that the survival of the management team is at the top of objectives list, can be connected to the hierarchical approach.

The application of the general target-setting model to the theory of the firm involves the two alternatives vectors x and x' representing business objectives or goals and the elements of the vectors are arranged in order of importance. Then as before $u(x) > u(x')$ on the basis of the ordered elements of the vectors and of the target levels symbolised as before with an asterisk. The preference ordering is exactly the same as the one presented in consumer theory the only difference being that the elements of the vectors or the utility vectors represent business goals. (For a psychological basis for this kind of business behaviour see McClelland, 1961 and Earl, 1990).

An example of the above with reference to Baumols' model has been given in the past by Encarnaciòn (1964b), Ferguson (1965) and Shubik (1961). Every possible situation is described by a vector

$$x = (x_1, x_2, x_3 \ldots x_m)$$

The optimal vector x is found by solving the following maximisation problem:

$$\begin{array}{cc} & \max x_m \\ & \text{s.t.} \\ x_i \geqslant x_i^* & \text{for } i = 1, 2, \ldots m-1 \end{array}$$

It is obvious that if this is not feasible then the x_{m-1} should be maximized.

More specifically, it is assumed that:
$x_1 = r$: the current ratio (the most important objective)
$x_2 = p$: the profit rate (the second most important goal)
$x_3 = k$: investment funds forthcoming
$x_4 = s$: growth of sales

It is also assumed that the investment funds forthcoming in the future are a function of the profit rate and the growth of sales:

$$k = g(p, s) \tag{1}$$

with

$$\frac{\partial k}{\partial p} > 0 \quad \text{and} \quad \frac{\partial k}{\partial s} > 0$$

Since we can only increase one variable at the expense of another (e.g. the increase of r can only come at the expense of p) it is true that

$$h(r, p, s;\ a) = 0 \tag{2}$$

the parameter a represents general market conditions. The optimum path for the firm can be seen in Figure 4. It is assumed that a satisfactory level of r is achieved, otherwise all situations will be ranked according to the first element only. It is also assumed that a satisfactory level of the second objective p is achieved. The figure represents a contour map of a four dimensional surface intersected by a plane at the level $r = r^*$. Since $p = p^*$ the origin is the point $(p^*, 0)$. The diagram is reduced to two dimensions by drawing 'indifference curves' for various k levels from equation (1). That is, solving $g(p, s) = p = a$ constant, one determines various combinations at p and s values giving rise to a stipulated k value. Also the curve $h(r^*, p, s;\ a_0)$ shows the transformation curve for the set of market conditions for the particular value a_0. The characteristic of all the equilibrium points A, B, D, is that the marginal rate of transformation equals the marginal rate of substitution between p and s for the given k level, as the parameter a varies. The initial equilibrium at point A is represented by the vector

$$X^{\mathrm{A}} = (r^*, p > p^*, k' < k^*, s < s^*)$$

At this point it is clear that the first two objectives are reached but the second two are not. Now if there is an improvement in market conditions (different value of a), the transformation curve shifts outwards to $h(r^*, p, s;\ a_1)$. Assuming that this improvement just satisfies the target level k^*, equilibrium point B is represented by the vector

$$X^{\mathrm{B}} = (r^*, p > p^*, k^*, s < s^*)$$

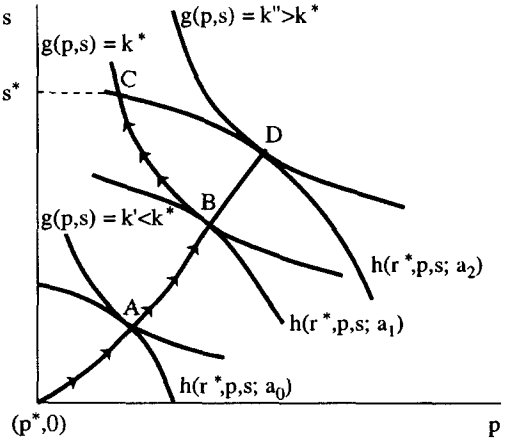

Figure 4.

Objective s is the only one not satisfied at point B. A further improvement in the market conditions which shifts again the transformation curve, will lead to point C and not D. This is because at point C the fourth objective is achieved although it implies a lower level of profit r and of forthcoming funds. A comparison of the corresponding vectors clarifies this

$$X^{D} = (r^*, p > p^*, k'' > k^*, s < s^*)$$

$$X^{C} = (r^*, p > p^*, k^*, s^*)$$

The equilibrium path from B to C ignores the tangency condition because profit and investment funds level become an 'inferior' objective once the target levels are satisfied.

The above approach which implies that firms meet some target levels of key objectives first before attempting to increase other objectives is supported by empirical studies. In particular, such studies indicate that pricing policies in firms reflect company policy priorities from among competing objectives (Lanzilloti, 1958 and Carter and Williams, 1958).

A further justification for the relevance of hierarchical model is the complex, and uncertain environment that firms operate subject to the important constraint of limited time to make decisions. Just like the individual agents, the above three factors tend to eliminate trade-offs from the belief system and to favour hierarchical behaviour. As Steinbruner states: '... [the mind or organisation] sets up separate decision problems, each governed by a single value or set of values hierarchically arranged' (Steinbruner,1974, p. 109). In other words, there is a problem decomposition mechanism which operates in a complex environment under time pressure (Earl, 1986, p. 180). The example that each organisation subunit has operational objectives different from other subunits is a classic one (Cyert and March, 1963). Some authors have studied the consequences of inappropriate problem decomposition by firms. According to many of them, the most important consequence is that the solution of one problem might imply failure to attain a satisfactory solution of another problem. (see Loasby, 1976; Steinbruner, 1974).

The application of hierarchical analysis in the theory of the firm can also be connected with Simon's satisficing theory (Simon, 1959, 1978). Simon emphasises the role of complexity and uncertainty and also the time constraint. Moreover, his ideas about procedural rationality, aspiration levels and satisficing can be accommodated in the above hierarchical model:

> If we seek to explain business behaviour in terms of this theory, we must expect the firm's goals to be not maximising profit, but attaining a certain level of profit, holding a certain share of the market or a certain level of sales. (Simon, 1959)

The certain levels that Simon refers to can be represented by the arbitrary levels x_n^* that we saw in the previous model. Also the behavioural model of the theory of the firm that was suggested by Cyert and March, and was based on Simon's

ideas can also be represented with the above model. In particular, their idea of sequential attention to goals (one problem at a time priority given to the most important and pressing one) is especially relevant (Cyert and March, 1963).

Social choice

The idea of hierarchical behaviour can be and has also been applied to the field of social choice. The type of a social welfare function which is closest to the essence of the hierarchical model is the Rawlsian social welfare function. The incorporation of the welfare of the worst off individual in society as the absolute minimum attaches a hierarchical flavour to this kind of social welfare function Rawls, (1971). Expressing the welfare function in to the form of a Bergson-Samuelson social welfare function (Bergson, 1938; Samuelson, 1947) which maps individual utilities into a level of social welfare, the standard formal statement of Rawlsian welfare function is the following:

$$W = \text{Min}(\{u^1(x_1), \ldots u^m(x^m)\}$$

A social state s' is preferred to another social state s'' if

$$\text{Min}\{u^1(x'^1), \ldots u^m(x'^m)\} \geqslant \text{Min}\{u^1(x''^1), \ldots u^m(x''^m)\}$$

The hierarchical nature of this welfare function can be clearly seen when the utilities of the worst-off persons in the two social states are equal. When this is the case the utility of the other persons (the better off) is considered. In a very simple situation of two persons (where u^1 is the utility of the worst off), two social states s' and s'' we have:

$$s' P s \text{ iff}$$

either 1) $u'^1 > u''^1$

or 2) $u'^1 = u''^1; u'^2 > u''^2$

It is clear that this is very similar to what we have termed strict hierarchical or lexicographic ordering. Other authors have attempted to apply the non-strict approach to social choice. Encarnaciòn for instance has made attempts to link the model to social choice. Encarnaciòn (1983) confronts the problem of social choice by considering the social utility function as a vector. There are alternatives and each alternative can be represented by a point in the space of objective variables:

$$z = (z^1, z^2 \ldots)$$

The next step is to form a function, defined over z which would express social preferences. Corresponding to each objective i there is a function

$$u^i = u^i(z^i)$$

such that: $u^i(x^i) > u^i(y^i)$ means that alternative x is preferred to alternative y, on the basis of objective i. It is also assumed that there exists arbitrary values $u^{*i} = u^i(z^{*i})$ where z^{*i} is a particular constraint level of z^i. The social utility

function can then be written as a vector of the following form:

$$u = (\min[u^1(z^1), u^{*1}], \min[u^2(z^2), u^{*2}], \ldots)$$

The ordering of alternatives now is very similar to the previous general model (also explained in the theory of the firm).

Another example of an application of the hierarchical approach to public choice setting is Brooks' (1988) work which contains a hierarchical treatment of an Edgeworth box in a simple framework of two individuals, two goods. The author emphasises the role of priority targets in an exchange situation and shows the usefulness of hierarchy in explaining some phenomena which the standard theory finds problematic. There is also a discussion of the implication of a change in the individual's target levels (see also Steedman and Krause, 1986).

The hierarchical character of the social utility function can prove quite useful in the case of multiple objectives. For instance it can be applied in the field of macroeconomic policy where constraints are common. For instance, if we have three objectives ordered as follows: unemployment (u), inflation (p) and budget deficit (b), the economic problem is:

$$\min b$$

s.t.

1) $p \leqslant p^*$ and 2) $u \leqslant u^*$

If the above is not feasible then we drop the least important objective, and the problem becomes:

$$\text{min. } p \text{ subject to } u \leqslant u^*$$

Tinbergen (1956, p. 59) expresses a similar idea when he writes about 'urgent' and 'less urgent' targets in macroeconomic policy. More recently Mosley's (1976 p. 60) work suggests that government decision-makers do not think in terms of optima, but rather in terms of values of targets. His explanation for this sort of behaviour is that it represents a compromise of conflict between different components of the government organisation. Mosley develops an empirical method of testing the target-setting behaviour of the government. His main specification is the following:

$$\Delta x_{i(t)} = a + \beta(y_i - y_i^*)_{(t-k)} \text{ when } y_i < y_i^*$$
$$\Delta x_i = 0 \qquad \text{at other times } (y_i \geqslant y^*)$$

where x_i is any policy instrument, y_i is any target, k is empirically determined lag and y_i^* is its desired value. Subsequently, he provides empirical evidence for the British and the US economies which indicates that the British and American Economic policies experience are characterised by target-setting (Mosley,1976, 1984).

It can also be argued that political parties exhibit hierarchical behaviour in the sense that political power is their priority objective while their actual policies a secondary one. This could explain the lurching around in policies at election

time. Similarly, another example of hierarchical behaviour is the 'sticking to principles' approach that leads some politicians to resign over a single issue.

There is of course the problem of Arrow's Impossibility Theorem and also the problem of setting appropriate levels of p^* or u^*. As far as the impossibility theorem is concerned, the fact that the arguments of the social choice function are social objectives and no individual preferences gives an interesting dimension to the issue. In particular, although the dictatorship condition remains, the hierarchical formulation can be shown to satisfy most of the other Arrow's conditions (Arrow, 1963 and Encarnaciòn, 1964c). The problem of setting appropriate levels of variables can be solved by simple majority voting system. Following Black on voting and preferences, the social u^{*1} for instance is the median of individual candidates for u^{*1}. A repetition of the procedure can be used to fix the next social target u^{*2} (or p^* in the macroeconomic policy case). Thus we have a social ranking of parameters (see Black, 1958, Encarnaciòn, 1983).

4. Conclusion

The starting point of this paper was to show that although the idea of perfect preference substitution has been extremely useful in economics, there is scope for the assumption of hierarchical preferences in numerous economic situations. It was seen that there are two categories of such preferences, lexicographic and target setting. The first category assumes no degree of preference substitution and this might be the reason why many theorists think of hierarchical choice in general as of limited relevance in economics. However, the second type which involves a considerable degree of substitutability, was seen to provide new insights into certain economic issues. It was also seen that a considerable amount of work has been done by a number of theorists. However, mainly because of the lack of recognition of the difference between the two types of hierarchical behaviour, this work has passed largely unnoticed by the majority of theorists.

Thus, the paper has attempted to illustrate the important distinction between the two types of behaviour and also to draw attention to some existing work which is based on hierarchical behaviour. In particular the implications of hierarchical preferences for demand theory, Engel curves, the theory of the firm and social choice were presented. It is clear that there are some very interesting possibilities and scope for further research. For instance, one can apply hierarchical preferences to other economic issues where a utility function is involved and where a minimum necessary level of one variable is plausible. One possible application could be the economics of taxation in relation to the incentive to work. Also hierarchical systems might be applied to bargaining theory. The idea of a trade union utility function which involves some minimum levels of employment and wages, can for instance be seen as another possibility.

In general, it is hoped that this discussion of the hierarchical model might provide the stimulus for new research in areas where unlimited substitutability seems to be an inappropriate assumption.

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