A Theory of the Firm Allowing for Multiple Objectives

Juan Hersztajn Moldau Professor da FEA-USP

RESUMO

A distinção entre os casos de objetivos múltiplos irredutíveis e de argumentos múltiplos da função utilidade é o ponto de partida da análise. Um primeiro caso é tratado empregando-se o princípio lexicográfico e mostra-se que os modelos de tipo Baumol e noções de comportamento tais como satisfação podem ganhar uma estrutura teórica. Mostra-se que a noção de satisfação implica a existência de equilíbrios múltiplos. No segundo caso, correspondendo às funções de utilidade da firma quando estas apresentam forma funcional, uma condição necessária implícita restritiva para a existência de uma função de utilidade específica é revelada.

PALAVRAS-CHAVE

teoria da firma, modelos de utilidade da firma, preferências lexicográficas, objetivos múltiplos, comportamento, satisfação, racionalidade limitada.

ABSTRACT

The distinction between the cases of multiple irreducible objectives and of a utility function's multiple arguments is the starting point of the analysis. A first case is treated employing the lexicographic principle and it is shown that the Baumol type models and behaviorist notions such as ***satisficing*** *can thereby gain a theoretical structure. It is shown that the satisficing notion implies the existence of multiple goals. The second case, corresponding to the utility functions of the firm when these display the functional form, an implicit restrictive necessary condition for the existence of a specific utility function is disclosed.*

KEY WORDS

theory of the firm, utility models of the firm, lexicographic preferences, multiple objectives, behaviorism, satisficing, bounded rationality

JEL Classification

D21, L21

INTRODUCTION

A basic assumption of the neo-classical theory of the firm is that of profit maximization. This condition has a strong operational appeal. It allows an analysis of the firm such that its decision makers' choice behavior is devoid of a deeper subjective content. A leading defense of this assumption is the **market selection argument** such as associated primarily with Friedman (1953) and Alchian (1950). However, this argument was recently challenged by Dutta and Radner (1999). Focusing mainly on the uncertainty case, with profits given by expected discounted withdrawals, they showed that most of the firms that survive in the long run are **not** profit maximizers, while those that maximize profit would tend to fail in a finite time period.

That profit maximization may represent an oversimplification of the decision making process at the firm, has been recognized for a long time. One can distinguish at least three basic alternative approaches: 1) the suggestion of a firm's utility function in terms of profit and other pecuniary objectives (see for example, BROWN & REVANKAR, 1971; LANDSBERGER & SUBOTNIK, 1976; MILLER & ROMEO, 1979) or encompassing non-pecuniary goals (see for example, SCITOVSKY, 1943; PIRON, 1974; AUSTER & SILVER, 1976; OLSEN, 1977; HANNAN, 1982; FORMBY & MILNER, 1985); 2) models where a given objective is maximized subject to a specific target constraint. Perhaps the best known example of a **target setting model** is that where revenue is taken as a decisive choice criterion, provided profits have attained a predetermined sufficiency level (see for example BAUMOL, 1958, 1959). Other instances are Yarrow (1976), where a firm's decision maker's utility is maximized subject to a minimum market valuation restriction and Williamson(1967), where utility given by excess expenditure on staff; management slack, and discretionary investment expenditure is maximized, subject to a minimum "reported" profit constraint (see HAY & MORRIS, 1991, p. 323); 3) the so called behaviorist mode of analysis including the treatment of the notions of **satisficing** and **bounded rationality** (see for example, SIMON, 1955, 1959, 1976, 1979,1987a; NELSON & WINTER, 1982; and CYERT & MARCH, 1992).

Given the simplifying assumption of profit maximization the standard theory of the firm focuses in general, upon a set of assumptions relative to the production set, without a significant concern for the explicit specification of the assumptions that underlie a decision maker's preferences. Unfortunately, the same procedure is also followed by most of the alternative approaches, thus neglecting an appropriate analysis of a possibly more complex preference structure underlying a firm's decision maker's behavior.

The model used here represents an effort to fill this gap by offering an axiomatic foundation to the mechanism of choice at the firm. A main objective of this paper is to present a framework that might be used to unify those different approaches to the theory of the firm including the conventional method. The explicit consideration of a decision maker's behavioral assumptions is shown to be an important ingredient in the existence proof of a firm's equilibrium under the various approaches, an issue that has been neglected in the literature. With regard to features that are typical of the behavioral line of thought I will suggest that the proposed framework may represent a contribution with respect to the provision of a still missing theoretical structure.

The reducibility and irreducibility of objectives are central concepts in my analysis, being related to two different meanings of the notion of objective. There is initially the idea that a decision maker is endowed with a finite set of irreducible criteria where each such objective can be considered as being of an abstract nature. It is further suggested that an **abstract objective** can eventually be decomposed into a finite set of what I will term **concrete objectives**, related according to subjective equivalence conversion factors. A significant example for the latter is the case of multiple goals as considered by the various **managerial utility** models described in the literature. Let us consider for instance, the managerial utility function U(Profit(.),Revenue(.)). Here we have the case of a single **abstract objective**, namely utility, decomposed into the **concrete**

objectives, profit and revenue. The existence of a utility function in this example implies that there is a subjective equivalence conversion factor, relating profit and revenue.[1] An example with two irreducible objectives is Williamson's (1967) model, where an abstract objective, perhaps inadvertently called utility, is decomposed into the concrete goals given by excess expenditure on staff, management slack and discretionary investment expenditure. Clearly here, utility is not a real valued representation of an agent's preferences, given the existence of reported profit, playing the role of another criterion, which is here irreducible with respect to the objective called utility, being predominant whenever its target value has not been reached.

This paper extends Hersztajn Moldau (1993) by treating the case of multiple irreducible objectives of the firm and by providing a detailed analysis of the particular case of a firm's utility model, allowing for multiple concrete goals. The first case is treated using the lexicographic principle. This implies that decision makers act in response to a set of ordered, but irreducible objectives. This means that decisions are made in accordance to a first ranking criterion. A second ranking objective is only decisive in choice if the alternatives that are being compared are indifferent with respect to the first rated objective. The other goals that follow with a lower order of importance are only considered, if the alternatives under comparison are indifferent in accordance to all criteria that have a higher importance ranking. It is to be noted, moreover, that when all objectives are reducible to a common denominator, there will be a single abstract objective and one or various concrete goals, and thus, we will have the utility maximizing model as a particular instance.

There are not many examples of other attempts to model the firm using the idea of lexicographic preferences. One can refer in this respect to a

1 The similar and well known idea, that the existence of a utility function in Consumer Theory implies the reducibility of needs or wants, has been presented forcefully by GEORGESCU-ROEGEN (1968) (see also SIMON (1987b, p. 244) and ARROW (1997, p. 759)). It is formally represented by the satisfaction of the continuity condition by a decision maker's preferences. On the other hand, the notion of subjectiveness must be properly understood in the context of a firm's decision maker.

paper published a long time ago by Encarnacion (1964). It is important, however, to note that the model used by this author corresponds to a very particular class of preferences, where a given objective may only cease to be decisive for choice, once it attained complete satisfaction. This means that this model displays a property of discontinuity in the ordering of objectives. The model that I am employing in this paper allows for a different view of the decision making process. It admits the possibility of a continuously varying ordering of criteria. Depending on the degree of satisfaction of the various objectives any of them could become of first order importance and eventually two or more could be simultaneously of first rank.

In Hersztajn Moldau (1993) it is shown that including this condition one can derive continuous demand functions with properties similar to those of demand functions derived according to the conventional approach. These properties include the possibility of a continuous and smooth substitution between goods in response to relative price changes. In general, one obtains the usual substitution term. However, a vanishing substitution term can be observed when the number of predominant criteria equals that of commodities. It also follows that the solution of the integrability problem may either lead to a conventional utility function or alternatively, to the real valued representation of a first ranking objective. This means that a given demand function can be consistent with preferences representable by a regular utility function, or alternatively, congruous with a lexicographic type of preferences, given in terms of a continuous ordering of goals. On the other hand, the existence of multiple irreducible objectives is shown to imply a unique equilibrium, even without the strict convexity of preferences property.

Considering the case of multiple concrete objectives, an important question to ask refers to the necessary conditions for the existence of a **specific** utility function given in terms of a particular set of arguments (concrete goals). Of significance in connection to this question is the fact that in the context of the theory of the firm, these arguments are in general functions of decision variables defined in the commodity space. This means that this type of utility function is actually a functional. A significant result of my analysis is the provision of a suitable framework to show the restrictiveness of the assumptions that necessarily underlie the neo-classical profit maximization model and each of the utility models of the firm. More precisely, I identify the form of the necessary subjective relationship between concrete goals so as to permit the existence of a specific utility function which is to serve as the real valued representation of preferences defined in the commodity space.[2] It is shown for example, that the existence of a utility function given in terms of only two arguments, such as for instance, profit and revenue, requires these to be independent. This means that the subjective conversion factor of revenue for profit must not change given a variation in the level of revenue and the subjective conversion factor of profit for revenue must stay the same given a change in profit. It is also shown in this case, how this may restrict a utility function's specification.

In this paper, I stress the point that the definition of a firm's utility function, necessarily implies the existence of the above mentioned subjective equivalence conversion factors to relate the concrete objectives that are arguments of the utility function in question. This means that a reference to multiple objectives should actually, in a rigorous sense, be restricted to the case where these are irreducible. In other words, when there are various objectives that are all reducible to a common denominator, one would in fact still be in the realm of the one objective models of the firm. This is in fact the main justification for my use of the term **concrete objectives** to set this case apart.

I also argue that our framework of analysis may represent an underpinning to the **target setting** approach, encompassing the Baumol type models, where one assumes that an agent must reach a target level of a first

2 It is useful to recall that the managerial utility functions are not defined in general, when their arguments are not cardinally measurable. A simple example is the utility function $U(x_1,f(x_2))$, where x_2 is ordinally measurable and f(.) is an increasing function from $\Re$ to $\Re$. Clearly, the first order condition for a constrained maximum of U(.) is affected by f(.). See for example, Georgescu-Roegen (1954, 1971, chapter IV) for a careful analysis of the distinction between cardinal and ordinal measurability.

ranked objective, before another can be the determinant of choice (see DRAKOPOLOUS, 1994). That these models represent a case of lexicographic preferences was suggested a long time ago by Rosenberg (1971). There are target setting models such as for example, Williamson's and Yarrow's, where one of the firm's objectives has a formal similarity with managerial utility functions. Thus, there is a connection which is explored with respect to the corresponding findings, briefly mentioned above. This makes the theory developed in this paper of particular interest for an analysis of the necessary conditions for an existence proof of a firm's equilibrium, while preserving those models' special features.

Another implication of our analysis is that features typical of the behavioral strand of thought can be reinterpreted in terms of a multiple objectives model of the firm with lexicographic preferences. I believe that of special significance is the proof that the well known **satisficing** concept implies the existence of multiple (irreducible) objectives. This result is then employed in an attempt to formalize the satisficing idea. Furthermore, it is suggested that this concept could then, eventually, be a part of a description of "rational" behavior corresponding to a more general model of choice applied to the firm. A point to be stressed is that by using a model that allows for the maximization of lexicographically ordered goals, one is able to pursue optimization procedures under circumstances that are inconsistent with profit or even with utility maximization.

The remainder of this paper is organized as follows. Section 1 presents the basic model. In section 2, I discuss models of the firm that allow for only one abstract objective. The analysis starts with the managerial utility models, emphasizing the role played by the above referred subjective equivalence conversion factors between concrete goals. It then follows a brief discussion of the neo-classical profit maximization model. Section 3 is devoted to the multiple objectives models of the firm. After a discussion of the Baumol type models, there is an attempt to apply the framework developed in this paper as a theoretical underpinning to concepts that belong to the behavioral strand of thought. Section 4 concludes the paper.

1. THE BASIC MODEL[3]

Decision making at a given firm is motivated by an ordered set of irreducible objectives and constrained by its limited technological knowledge and by the prices of commodities. The symbol y represents a given production or activity at a given firm. It is a vector in $Y \subseteq \Re^n$, where Y corresponds to a firm's choice set and n is assumed finite, representing the total number of commodities that are transformed or used in the production process. I will also assume that Y is closed and convex. I will follow the usual practice and distinguish the output elements from the inputs by attributing a non-negative sign to the former and a non-positive sign to the latter. The set Y' of all productions that are technically feasible is denoted the production set. I will assume that Y' is closed and bounded.[4]

Let us now introduce the basic concepts that underlie the determination of the preferences of a firm's decision maker.[5] I will adapt to the present model concepts defined in section II of Hersztajn Moldau (1993). It is assumed that one can associate to a given firm a set of objectives denoted by J taken to be finite and formed by m elements, {a,b,...j,...}, where $m \geq 1$. The model's primitive concept is given by an objective's relative importance. Let us define the binary relation $\hat{\geq}$ over the product space JxY of pairs (j, y), $\forall j \in J; \forall y \in Y$. It follows that $(j, y^1) \hat{\geq} (h, y^2)$ means

3 The initial portion of this section (mainly, parts of p. 7-9), treating a firm's preference relation, draws heavily on HERSZTAJN MOLDAU (1993).

4 The boundedness condition may be questioned for not being strictly related to a firm's technology. I am nevertheless, adopting it here not only because it is justifiable on other grounds, but mainly, to allow us to focus the study of the existence conditions of a firm's equilibrium on its decision maker's behavioral or subjective properties.

5 I am not discussing in this paper the principal-agent problem, involving owner-manager interactions. I am basically considering the preferences of a given ultimate decision making entity. There is a growing literature on the contractual view of the firm, including work intended to go beyond firm's traditional, so called "black-box" representation. See HOLMSTROM & TIROLE (1989) for a detailed account. One can also mention specific work on managerial incentives that discusses the possibility of a firm's owners maximizing profit, while managers are induced to pursue other goals, such as increased sales. For example, this is in accordance with a firm's strategy to increase its output share in an oligopoly setting. See for example, FERSHTMAN & JUDD (1987), SKLIVAS (1987) and SEN (1993).

that objective j at y^1 is at least as important as objective h at y^2; j, h$\in$J and y^1, $y^2\in$Y. The relations $\hat{>}$ (more important than) and $\hat{=}$ (as important as) can be defined as follows:

$$\forall j, h \in J; \forall y^1, y^2 \in Y$$

$$(j, y^1) \hat{>} (h, y^2) \Leftrightarrow (j, y^1) \hat{\gtrsim} (h, y^2) \text{ and } \neg(h, y^2) \hat{\gtrsim} (j, y^1)$$

$$(j, y^1) \hat{=} (h, y^2) \Leftrightarrow (j, y^1) \hat{\gtrsim} (h, y^2) \text{ and } (h, y^2) \hat{\gtrsim} (j.y^1).$$

Define $\succeq_j$ the binary weak preference relation on Y according to j$\in$J as $y^1 \succeq_j y^2 \Leftrightarrow (j, y^2) \hat{\gtrsim} (j, y^1); \forall y^1, y^2 \in Y; \forall j \in J.$

This means that an agent will always aim at the reduction of the importance of a given criterion.

Define $\succ_j$, the preference relation on Y according to j and define $\cong_j$, the indifference relation on Y, corresponding to j as

$$\forall y^1, y^2 \in Y; \forall j \in J \qquad y^1 \succ_j y^2 \Leftrightarrow y^1 \succeq_j y^2 \text{ and } \neg y^2 \succeq_j y^1$$

$$y^1 \cong_j y^2 \Leftrightarrow y^1 \succeq_j y^2 \text{ and } y^2 \succeq_j y^1$$

I will assume that the following axioms are fulfilled by the mechanism of choice:

Axiom A_1. *Completeness* - Given any j,h$\in$J and given any y^1, $y^2\in$Y, either $(j, y^1) \hat{\gtrsim} (h, y^2)$ or $(h, y^2) \hat{\gtrsim} (j, y^1)$.

Axiom A_2. *Transitivity* - $\forall y^1, y^2, y^3 \in Y; \forall j, h, g, \in J, [(j, y^1) \hat{\gtrsim} (h, y^2)$ and $(h, y^2 \hat{\gtrsim} (g, y^3) \Rightarrow (j, y^1) \hat{\gtrsim} (g, y^3)]$.

Axiom A_3. *Continuity of* $\succeq_j$ *on* Y - $\forall y' \in Y$, $\forall j \in J$, the sets $\{ y \in Y / y \succeq_j y' \}$ and $\{ y \in Y / y' \succeq_j y \}$ are closed in Y.

Axiom A'_3. *Continuity of* $\hat{\geq}$ *on* JxY - $\forall$ $y \in Y$, $\forall j, h \in J$, $j \neq h$ [$\exists y' \in Y$: $(j,y) \hat{=} (h,y')$ or $\forall y' \in Y$: $(j,y) \hat{>} (h,y')$ or $\forall y' \in Y$: $(h,y') \hat{>} (j,y)$].

Axiom A_4. *Convexity of* $\succeq_j$ - If $y^2 \succ_j y^1$ then $ty^2 + (1-t)y^1 \succ_j y^1$ for $0<t<1$ and $\forall j \in J$.

Axioms A_1 and A_2 impose, respectively, the properties of completeness and transitivity upon the criteria of choice. A_3 imposes the continuity property upon each choice criterion. This is at variance with the standard procedure in which these properties are imposed upon a decision maker's preference relation. Note that A_1 implies the perfect knowledge of all relevant attributes of commodities, including prices, as these could be involved in the definition of specific objectives. In this model the preference relation is not a primitive concept but rather defined in terms of a more basic primary notion, namely a criterion's relative importance.

Axiom A'_3 implies that the ordering of objectives satisfies the continuity property. This condition is congruous with a perhaps more acceptable sort of lexicographic ordering, as it allows two or more objectives becoming simultaneously predominant. At the same time, this assumption is also consistent with a given objective relinquishing its predominance status, before reaching satiation. Finally, A_4 simply means that there is no preference for specialization with respect to any commodity with regard to the satisfaction of any objective.

A_1 and A_2 imply that J is completely preordered by $\hat{\geq}$ for all y in Y. The overall preference relation on Y by a given firm's decision maker[6] can be

6 I am not addressing the question of how to aggregate the individual preference relations in those cases where decisions at the firm are carried out by more than one individual.

obtained with assistance of Sen's leximin rule (see SEN, 1986; and HAMMOND, 1976). For each y∈Y give each objective j∈J a ranking number k(j,y). These numbers order the objectives in terms of their importance. Smaller numbers are thus, associated with greater importance. Each j∈J at any y∈Y is related to an integer 1≤k(j,y)≤m so that $(j,y)\hat{>}(h,y) \Rightarrow k(j,y)<k(h,y)$, j,h∈J, y∈Y. When ties are observed for $(j,y)\hat{=}(h,y)$, j,h∈J at y∈Y, these ties can be broken arbitrarily. It follows that at any y∈Y, for each 1≤k≤m there is a unique objective j(k,y) whose rank at y is k. However, in this paper, any reference to a first ranking objective will also apply to any other goal that is tied to it.

Let us now adapt Hersztajn Moldau's (1993) definition of the order of criteria's preference relations and of the overall preference relation to a firm's objectives.

The binary weak preference relation $\succeq_k$, corresponding to a firm's kth ranked objective, is defined by

$$y^2 \succeq_k y^1 \Leftrightarrow (j(k,y^1),y^1) \hat{\geq} (j(k,y^2),y^2)\,;\ \forall y^1,y^2 \in Y,\ \forall k \leq m.$$

The preference ($\succ_k$) and indifference ($\cong_k$) relations, corresponding to a firm's kth ranked objective, are given by

$$\forall y^1,y^2 \in Y;\ k \leq m \qquad y^1 \succ_k y^2 \Leftrightarrow (j(k,y^2),y^2) \hat{>} (j,(k,y^1),y^1);$$

$$y^1 \cong_k y^2 \Leftrightarrow (j(k,y^1)y^1) \hat{=} (j(k,y^2),y^2).$$

One can define a firm's decision maker's overall preference relation $\succ$, by $y^1 \succ y^2 \Leftrightarrow \exists G \geq 1$ *such that* $y^1 \cong_k y^2$ *for* $k < G$ *and* $y^1 \succ_G y^2;\ \forall y^1, y^2 \in Y$

A firm's decision maker's overall indifference relation $\cong$, can be defined by

$$y^1 \cong y^2 \Leftrightarrow y^1 \cong_k y^2;\ k = 1 \ldots m,\ \forall y^1, y^2 \in Y.$$

Finally, the overall weak preference relation $\succeq$, is simply given by

$$y^1 \succeq y^2 \Leftrightarrow y^1 \cong y^2 \ \ or \ \ y^1 \succ y^2; \forall y^1, y^2 \in Y.$$

In Hersztajn Moldau (1993) it is shown that A_1 and A_2 imply that the relations $\succeq_j$, $\succeq_k$ and $\succeq$ are complete, reflexive and transitive on Y, $\forall j \in J$ and $\forall k \leq m$. Therefore, the addition of A_3 implies the existence of a real valued and continuous representative function of $\succeq_j$ on Y denoted by $U^j(y)$, $\forall j \in J$. It is also demonstrated that given A_1, A_2, A_3 and A_3' the relations $\succeq_k$, $\forall k \leq m$ are continuous on Y and thus, there is a continuos real valued representation for each $\succeq_k$ on Y denoted by $U^k(y)$, $\forall k \leq m$.[7] It follows that

$$(j(k,y^1),y^1)\,\hat{\geq}\,(j(k,y^2),y^2) \Leftrightarrow U^{j(k,y^1)}(y^1) \leq U^{j(k,y^2)}(y^2)$$

If $j(k,y^1)=j$ (j is the kth ordered goal at y^1) and $j(k,y^2)=h$, one may write

$$(j,y^1)\,\hat{\geq}\,(h,y^2) \Leftrightarrow U^j(y^1) \leq U^h(y^2) \qquad (1)$$

The prices corresponding to the commodities that represent the inputs and outputs relevant to a given firm are given by the market, and will be denoted by p. The price system p is a vector in $P \subseteq \Re^n_{++}$. Clearly, the type of market organization assumed to be in effect will explain the rule relevant for the determination of p. Consider y^+ which represents the sum of the exogenously given activities of all the other firms in the economy. Y'^+ represents the sum of the production sets of all the other firms in the economy and is denoted the **complementary total production set**. The following assumption imposes the condition that a given firm takes prices in the output and input markets as given.

7 If a transformation is applied to one criterion's preference representation, then the same transformation must be applied to that corresponding to all other objectives. See HERSZTAJN MOLDAU (1993, p.363). This idea is similar to Sen's "ordinal level comparability property" (see SEN, 1986).

Assumption B. *Perfect Competition* - Given $p = p(y, y^{+})$, $y \in Y'$, $y^{+} \in Y$, $p \in P, \dfrac{\partial p_i(y)}{\partial y_i} = 0$, $i \in [1,\ldots n]$, $\forall y \in Y'$, $y_i^{+} \neq 0$.

Assumption B assumes the knowledge of the market demand (supply) function for each commodity. Let $\psi(p)$ denote a firm's supply (demand) correspondence and $\theta(p)$ its supply (demand) function if single valued, under B. In order to discuss the question of the existence of a supply function or correspondence, one must initially discriminate between pecuniary and non-pecuniary objectives. Let us propose a simple distinction, by defining a **pecuniary** objective as one that includes the price of at least one commodity in its specification.[8] Well known examples are profit and revenue. Instances of **non-pecuniary** objectives, defined so as to exclude prices in their definition, are effort minimization, leisure, staff, employment, the output level, etc.

It is clear that one can only speak of a firm's supply function or correspondence if at least one of the objectives in J that compose the first ranking criterion is of the pecuniary type. The next Proposition and Corollary are concerned with the existence proof of a firm's supply correspondence or function:

PROPOSITION 1. *Given A_1- A_3' and B, a supply (demand) correspondence $\psi(p)$ is well defined from P to Y provided there is a predominant pecuniary objective for any $y \in Y$.*

PROOF:

We must search for a greatest element of a given production set according to a preference relation given by criteria, some of which include prices in their definition.

8 The definition of pecuniary objectives implies that p could be an argument of U^j, if j is of the pecuniary sort. Given that in general, p is not an independent decision variable, it may in most cases be omitted as an argument of U^j.

Let $C^k_{y'} = \{y \in Y / y \succeq_k y'\}$, y'∈Y, 1≤k≤m. Assume that for any y in Y there is a predominant pecuniary objective. Then for each p in P we have $\Psi = \bigcap_{y \in Y'} (C^1_{y'} \cap Y') \neq \varnothing$. This follows from Theorem 5 in Uzawa (1971), from Y' being compact, and from A_3, A_3' and Theorem 4 in Hersztajn Moldau (1993). If there is only one element in Y the proposition is proved. If not, Theorem 6 in Hersztajn Moldau (1993) implies that also the subset of greatest elements in Ψ, according to ≥ is non-empty. Given that the subset of greatest elements of Y', according to ≥, belongs to Ψ, the proposition is established.[9]

In order to demonstrate the existence of a supply function from P to Y, one should preclude from consideration those cases where two activities are indifferent according to all objectives in J. These situations can be understood as implying that there is actually a single objective relevant for the comparison of such activities. We may thus employ the following condition, similar to one proposed by Hersztajn Moldau (1993):

Condition γ. Given any two distinct activities y^1 and y^2 in Y' there is j∈J such that either $y^1 \succ_j y^2$ or $y^2 \succ_j y^1$.

COROLLARY 1. *Given A_1- A_4, B and γ, a supply (demand) function θ is well defined from P to Y, provided there is a predominant pecuniary objective at any $y \in Y$.*

PROOF:

The assertion follows from Theorem 6 in Hersztajn Moldau (1993).

9 Clearly, a similar proof also implies the existence of an equilibrium when there is no predominant pecuniary objective in Y. In subsection 3.1 we also discuss the existence of an equilibrium when the continuity of the ordering of objectives property A'_3 is not fulfilled.

2. *UTILITY MODELS OF THE FIRM*

Clearly, when m = 1 the weak continuity condition A_3 translates into the usual continuity property of the overall preference relation $\succeq$. Hence, one could then in principle, refer to utility models of the firm. In this section I will show that assuming the conditions A_1-A_3 for m = 1 is not sufficient for an existence demonstration of a **specific** managerial utility function. I will in this section focus on the case where an abstract objective called utility, is decomposed into a finite set of concrete objectives that are functions of $y \in Y$, that represent a firm's ultimate decision variables. Let us propose the following general definition of the notion of concrete objective:

Definition 1. An objective $j \in J$ of a given firm can be decomposed into a finite set of **concrete objectives** $g=a.....v$, if for any r and s, $r,s \in [a...v]$, there are functions $O^j_{rs} = \gamma_{rs}(O^j_s(y))$ and $\sigma^*_{rs} = \sigma_{rs}(y)$ such that $O^{j*}_{rs} = \Im_{rs}(\sigma_{rs}(y), \gamma_{rs}(O^j_s(y)))$ at any $y \in Y$. The functions $O^j_{rs} = \gamma_{rs}(.)$ and $\sigma^*_{rs} = \sigma_{rs}(.)$ are respectively termed **direct subjective equivalence conversion factor** and **subjective equivalence weight**, each O^j_g is assumed to represent a cardinal measure of g and O^{j*}_{rs} is the level of r that is indifferent to the attainment level $O^j_s(y)$ of s with respect to j, at y.

$\Im_{rs}(.)$ is a general expression of the subjective reducibility of any two objectives in terms of a common denominator. The functions $\sigma^*_{rs} = \sigma_{rs}(y)$ and $O^j_{rs} = \gamma_{rs}(O^j_s(y))$ play distinct roles in the definition of the subjective equivalence relation between r and s. The expression $\gamma_{rs}(O^j_s(y))$ is a function restricted to represent the direct effect of the level O^j_s of s with respect to the corresponding indifferent value O^{j*}_{rs} of r. The expression σ_{rs} (y) on the other hand, is a function that may include the effect of variables distinct from O_s^j, showing how these could affect the O_{rs}^j value that is indifferent to O_s^j by virtue of only this variable. The term σ_{rs}^* could vary with y, by embodying the effects caused by possible changes of the accomplishment levels of concrete objectives other than *s* with respect to y.

Consider a decision maker's preference relation $\succeq$, fulfilling the conditions A_1-A_3 on Y, with m = 1. When a particular utility function defined in terms of a finite set of concrete objectives g = *a..v* is the real valued representation of $\succeq$ on Y it is given by a functional such as $U(O_g(y))$, g = *a...v*, $y \in Y$. Given the property of reducibility of the concrete goals g = *a..v*, their abstract common denominator U(.) can be substituted by any other common denominator g and the utility function may then be rewritten in terms of a proposed **extensive form**, expliciting these goals' subjective conversion factors and equivalence weights: $O_r^* = \{O_r(y) + \sum_{s,s \neq r} \Im_{rs}[\sigma_{rs}(y), \gamma_{rs}(O_s(y))]\}, \forall r, s = a..v$. In this expression O_r^* is the level of *r* that is indifferent to the attainment levels of all g given at a specific y.

2.1 *Utility Models with Multiple Arguments*

Consider initially that a utility function $U(O_g(.))$ is defined for g = *a..v*, $v \neq a$. Let us assume that $U(O_g(.))$ and $O_{rg} = \gamma_{rg}(O_g(y)$ are differentiable with respect to O_g, g = *a..v*, $\forall r$ and $\sigma_{rg}(y)$ and O_g, g = *a...v*, $\forall r$, are differentiable with respect to y.

The following proposition states the main result of the present section. It is shown that when a specific utility function with the functional form is the representation of preferences on Y, this implies a particular subjective relation between its arguments. More precisely, this means that the effects of the rates of change of their subjective equivalence weights with respect to a given commodity cancel out.

PROPOSITION 2. *Given* $O_{rs}^{j*} = \Im_{rs}(\sigma_{rs}(y), \gamma_{rs}(O_s^j(y)))$, *s=a...v,* $\forall r$, *s≠r, the maximization of a firm's utility function* $U(O_g(y))$, *g=a...r,s...v, v≠a, with respect to* y_i, $\forall i$, *implies that the subjective equivalence weights* $\sigma_{rs}^* = \sigma_{rs}(y)$, *s=a...v, fulfill* $\sum_{s,s\neq r}\{(\partial O_{rs}^{j*}(.)/\partial\sigma_{rs}^*)(\partial\sigma_{rs}^*/\partial y_i)\} = 0$, $\forall r$.

PROOF:

We may omit j, since m = 1. Consider that the choice variables are defined in Y. Let us then write the first order condition for a maximum of $U(O_g(y))$ (the constraint $y \in Y$' will be omitted in this whole proof for convenience). After algebraic manipulations we have:

$$\frac{\dfrac{\partial O_r}{\partial y_i}}{\dfrac{\partial O_s}{\partial y_i}} = -\frac{\dfrac{\partial U}{\partial O_s}}{\dfrac{\partial U}{\partial O_r}} - \sum_{z\neq r,s}\frac{(\dfrac{\partial U}{\partial O_z})(\dfrac{\partial O_z}{\partial y_i})}{(\dfrac{\partial U}{\partial O_r})(\dfrac{\partial O_s}{\partial y_i})}, \quad i=1........n. \tag{2}$$

Consider $\sigma_{rs}^* = \sigma_{rs}(.)$ and $O_{rs} = \gamma_{rs}(.)$ such that $O_{rs}^* = \Im_{rs}[\sigma_{rs}(y), \gamma_{rs}(O_s(y))]$, $\forall r$; $s = a..v$; $s\neq r$. We will now attempt to determine a firm's equilibrium by solving $\max O_r^* = \max\{O_r(.) + \sum_{s,s\neq r}\Im_{rs}[\sigma_{rs}(.), \gamma_{rs}(O_s(.))]\}(.)+\}, \forall r, s = a..v$. Our aim will be to search for a necessary requirement to obtain a first order condition similar to (2). Consider the first order condition for a maximum of O_r^* with respect to y:

$$\frac{\partial O_r}{\partial y_i}+\sum_{s\neq r}\{(\frac{\partial O^*_{rs}}{\partial \sigma^*_{rs}})(\frac{\partial \sigma^*_{rs}}{\partial y_i})\}+\sum_{s\neq r}\{(\frac{\partial O^*_{rs}}{\partial O_{rs}})(\frac{\partial O_{rs}}{\partial O_s})(\frac{\partial O_s}{\partial y_i})\}=0,\ i=1....n. \quad (3)$$

Given that $(\partial O^*_{rs}/\partial O_{rs})(\partial O_{rs}/\partial O_s) = (\partial O^*_{rs}/\partial O_s(.)) = (\partial U/\partial O_s)$ $/(\partial U/\partial O_r)$,[10] performing a few algebraic transformations on (3) we obtain

$$\frac{\frac{\partial O_r}{\partial y_i}}{\frac{\partial O_s}{\partial y_i}}=-\frac{\frac{\partial U}{\partial O_s}}{\frac{\partial U}{\partial O_r}}-\sum_{z\neq r,s}\frac{(\frac{\partial U}{\partial O_z})(\frac{\partial O_z}{\partial y_i})}{(\frac{\partial U}{\partial O_r})(\frac{\partial O_s}{\partial y_i})}-\sum_{s\neq r}(\frac{\partial O^*_{rs}(.)}{\partial \sigma^*_{rs}})(\frac{\partial \sigma^*_{rs}}{\partial y_i}),\quad i=1....n.$$

It follows that we will only achieve an expression similar to (2), necessary for the maximization of $U(O_g(y))$, g = a..v, with respect to y, if

$$\sum_{s\neq r}(\frac{\partial O^*_{rs}(.)}{\partial \sigma^*_{rs}})(\frac{\partial \sigma^*_{rs}}{\partial y_i})=0,\quad i=1....n. \quad (4)$$

Given that the maximization of a utility function $U(O_g(.))$, $g = a..v$, with respect to y implies (4), variable σ^*_{rs} s with respect to y that do not fulfill (4) are inconsistent with the maximization of this utility function.[11] Any attempt to determine a firm's equilibrium using this utility function or by solving the equivalent max O^*_r problem, $\forall r$, may then be expected to lead to ambiguous results. However, to assume that the σ^*_{rs} s fulfill (4) could

10 The subjective marginal equivalence relation between O_r and O_s when all other O_g are constant is here written in terms of U(.), which is simply one of the possible common denominators of the concrete goals in question.

11 This statement is consistent with logic's well known laws of contraposition and hypothetical syllogism.

be a very restrictive hypothesis. A change in y by affecting the accomplishment levels of *r* and of the other concrete goals may change the level of O_r that is indifferent to a given O_s. This means that a given σ^*_{rs} may be sensitive to the goals' accomplishment levels and hence, vary with respect to y, according to the concrete objectives' possible relations of complementarity or substitutability.

In order to clarify this statement let us propose the following definition of complementary, substitutive or independent concrete objectives.

Definition 2. Consider the extensive form of a utility function $U(O_g(y))$, $g = a....v$, given by $O^*_r = \{O_r(y) + \sum_{s,s\neq r} \Im_{rs}[\sigma_{rs}(y), \gamma_{rs}(O_s(y))]\}, \forall r, s = a..v$. The concrete objectives *s* and *z* are **complements, substitutes** or **independent** in terms of the concrete goal *r* at $y \in Y$, if, respectively, $\partial^2 O^*_r / \partial O_s.\partial O_z = \partial^2 O^*_r / \partial O_z.\partial O_s > 0$; $\partial^2 O^*_r / \partial O_s.\partial O_z = \partial^2 O^*_r / \partial O_z.\partial O_s < 0$; $\partial^2 O^*_r / \partial O_s \partial O_z = \partial^2 O^*_r / \partial O_z.\partial O_s = 0$; $\forall r$.

It is noteworthy that a significant feature of the extensive form of the utility function is its cardinality which is a property of the arguments of a regular utility function (see note 2). This feature makes the proposed definition of complementarity immune to the indeterminateness eventually displayed by the Edgeworth-Pareto cross derivative sign definition, when applied to an ordinal utility function (see SAMUELSON, 1974) for an authoritative account on complementarity).

The associations of complementarity, substitutability or independence that are possibly implied by (4) could eventually, represent a test for its reasonableness as a necessary existence condition of a specific utility function.[12] A significant case is that corresponding to the often encountered

12 Assuming that Y' is compact it follows that the constrained maximization of a given $U(O_g(y))$ has a solution. Therefore, failure of the condition (4) and thus of (2), implies the nonexistence of this specific utility function.

utility functionals with only two arguments. According to Corollary 2 below, condition (4) would then imply that the concrete goals in question hold a very particular relationship:

COROLLARY 2. Assume that a utility functional with two arguments, of the form $U(O_r(y),O_s(y))$ fulfills the necessary condition (4) at $y \in Y$. This implies that the concrete goals r and s are independent at y.

PROOF:

Using Definition 2, with O_s in place of O_z, the result follows easily after inserting (4) in equation (3).

This result may impose a constraint on the form of a feasible utility function meant to represent preferences on Y. The following example is an illustration.

Example 1. Let the Cobb-Douglas form $U=O_r^{\,a}O_s^{\,b}$, with $a,b>0$, be a firm's tentative utility function for finite values $O_r(y)$ and $O_s(y)$. By imposing the condition $dU=0$ we obtain $dO_r^* / dO_s = -bO_r / aO_s$ and it follows that $\partial^2 O_r^* / \partial O_s \partial O_r = -(a+b)/aO_s \neq 0$.

Given that r and s are not independent it follows from Corollary 2 that (4) is not fulfilled. Therefore, a Cobb-Douglas type utility functional can not be a representation of a decision maker's preferences $\succeq$, on Y.

Given that the nonindependence of two concrete goals r and s implies that (4) will not be satisfied, the existence of a corresponding type of utility functional representing preferences on Y will then require the addition of at least another concrete goal z keeping a complementarity or substitutability relation with r or s, consistent with the particular relation prevailing between r and s, so as to make feasible the satisfaction of condition (4). This follows, because with only two concrete goals, the sign of (4), determines the sign of the complementarity/substitutability term of

Definition 2. With the addition of a given z, (4) implies then a determinate complementarity/substitutability term between, for example, r and z taken in isolation.[13]

2.2 The Neoclassical Profit Maximization Model

Consider the following utility functional written in its extensive form, $O_r^* = \{O_r(.) + \sum_{s,s\neq r} \Im_{rs}[\sigma_{rs}(.), \gamma_{rs}(O_s(.))]\}$, where *r* represents the profit goal and *s=a....v*, corresponds to a finite set of other conceivable concrete objectives. When the direct subjective equivalence conversion factors of profit with respect to those other goals are equal to zero we have the conventional profit maximization model. In other words, $O_r^* = O_r(.)$ and the "subjective content" of our objective function has thus, been eliminated. Therefore, profit is the single concrete objective which can be maximized in place of utility. The "value" of profit is unaffected by any other conceivable goal and all sources of profit are indistinguishable.

From a purely formal perspective the restrictiveness of the profit maximization hypothesis is made clear by observing that at any point in Y and thus, given any possible profit level, no increase in the level of attainment of any other possible goal is acceptable in exchange for even the slightest reduction in profit. It is however noteworthy that profit maximization might be consistent with the existence of multiple irreducible objectives when considering those activities where profit is the predominant goal.

13 By decomposing (4) in terms of the concrete goals included in each σ_{rs}^*, r,s∈[a...v], one can verify that this condition implies that when the concrete goals are not independent they must fulfill particular combinations of complementarity and substitutability relations. Furthermore, it is clear that an ever increasing set of such combinations is feasible as the number of arguments of U(.) increases. This would then mean a decreasing degree of restrictiveness imposed by condition (4).

3. ANALYSIS OF THE FIRM ADMITTING MULTIPLE IRREDUCIBLE OBJECTIVES

A possibly significant application of the model presented in section 1 is the provision of a better understanding of theories of the firm that neither conform to the neoclassical paradigm, nor to the various managerial utility models. I will argue that at least some of those theories correspond to cases where multiple irreducible objectives could be the determinants of choice at the firm.

I will here concentrate on two approaches that fit into this category. I will initially relate the analysis developed in this paper to constrained maximizing models such as the revenue maximization models introduced by Baumol (1958). I will then argue that some concepts used by behaviorists could be reinterpreted in terms of the possible existence of multiple criteria. It is suggested that this could imply the possibility of extending the maximizing or optimizing form of reasoning to at least some situations treated in the behavioral approach.

3.1 Maximizing Models With a Specific Constraint

The profit constrained revenue maximization model developed by Baumol, as well as models such as Yarrow's (1976) and Williamson's (1967) could be interpreted as having multiple objectives without imposition of assumption A_3' (continuity of the ordering of objectives) and possibly of B (perfect competition) in all markets. We would thus, actually have models more akin to the lexicographic ordering suggested by Georgescu-Roegen (1954, 1968), formalized by Encarnacion (1990) and used, among others, by Rawls (1971).

My concern in this section is to present the conditions that are necessary for the existence proof of an equilibrium for this type of model. The distinguishing feature of most of these models is the existence of two irreducible objectives, that I denote by j and h, that are decomposable into a given set of concrete goals. There are basically two cases to consider. The simplest one is that where both j and h have a real valued representation with a single argument that is a function of y in Y. The classical Baumol model is the outstanding example. The other case is such that at least one of the irreducible objectives in question has a real valued representation which is a functional with a specific set of multiple arguments. Possible examples are the models developed by Yarrow and Williamson. Proposition 3 then shows that the existence of an equilibrium solution in each of these models implies the satisfaction of the assumptions A_1, A_2 and of the weak continuity property A_3 in the appropriate subsets of $\Re^n$. It is also shown that the fulfillment of property (4) of the subsection 2.1. is implied in a nonvacuous manner if the real valued representation of either j or h displays the functional form with multiple arguments. When such representation includes a single argument, condition (4) is automatically satisfied.

PROPOSITION 3. *Assume a firm's preference relation $\succeq$ on Y such that $J=\{j,h\}$; j is predominant at $y \in Y$ such that $U^j(y) < \bar{U}^j$ and h is of first order importance in $\tilde{Y} = y \in Y : U^j(y) \geq \bar{U}^j$. Suppose that $U^j(y) = U^j(O_g(y))$, $g=a...v$ and $U^h(y) = U^h(O_{g'}(y))$, $g'=a'...v'$, are the real valued representations of respectively, $\succeq_j$ on Y and $\succeq_h$ on $\tilde{Y}$. Assume for simplicity that $\succeq_j$ fulfills A_4 and that Y' is strictly convex. The existence of an activity in Y' which is weakly preferred to any other in Y' according to $\succeq$ implies the fulfillment of A_1, A_2 on Y; of A_3 by $\succeq_j$ on Y; of A_3 by $\succeq_h$ on $\tilde{Y}$ and of condition (4) by $U^j(O_g(y))$ and $U^h(O_{g'}(y))$.*

PROOF:

Condition A'_3 is not fulfilled in Y as there is a discontinuity in the ordering of objectives at $\hat{y}$ such that $U^j(\hat{y}) = \bar{U}^j$ (see Corollary 3 in subsection 3.2). Therefore, the utility functions $U^k(.)$, k=1...m are not defined. A firm's problem of determining its chosen activity can be addressed in two stages. One can initially solve

$$\max U^J(O_g(y)),\ g=a...v \text{ s.t. } y \in Y' \text{ and } p=p(y,y^+). \tag{5}$$

Suppose that y' solves (5) for a given p in P and that $U^j(y') < \bar{U}^j$. It follows that $y' \succeq y$, $\forall y \in Y'$, since $j=j(1,y)$, $U^j(y') \geq U^j(y)$, $\forall y \in Y'$ and given that Y'is strictly convex and $\succeq_j$ fulfills A_4. If $U^j(y') \geq \bar{U}^j$ a second step will be necessary to determine a firm's equilibrium:

$$\max U^h(O_g(y)),\ g'=a'...v' \text{ s.t. } y \in Y' \cap \tilde{Y},\ \text{and } p=p(y,y^+) \qquad (6)$$

Assume that y" is a solution of (6). If unique it follows that $y'' \succeq y$, $\forall y \in Y'$, since $h=j(1,y)$ and $U^h(y'') \geq U^h(y)$, $\forall y \in Y' \cap \tilde{Y}$. Clearly, $Y' \cap \tilde{Y} \neq \emptyset$ given that we are here assuming that there is $y' \in Y'$ such that $U^j(y') \geq \bar{U}^j$. If that solution is not unique, denote by ψ the set of elements that solve (6). The firm's equilibrium will then be given by the solution of

$$\max U^j(O_g(y)),\ g=a...v,\ \text{s.t. } y \in \psi \text{ and } p=p(y,y^+).$$

The existence of a solution for the proposed maximization problem, Y' being a compact set, implies A_1, A_2 and that $\succeq_j$ and $\succeq_h$ fulfill A_3, respectively on Y and on $\tilde{Y}$. This guarantees the existence of a real valued representation of $\succeq_j$ on Y and of $\succeq_h$ on $\tilde{Y}$. In view of Proposition 2, the satisfaction of condition (4) by $U^j(O_g(y))$, $g=a...v$, and by $U^h(O_g(y))$, $g'=a'...v'$, is also implied for these specific utility functions to correspond to the representations in question of $\succeq_j$ and $\succeq_h$.

When $U^j(y)$ and $U^h(y)$ are respectively proposed as $U^j(O_g(y))$ for $g=a$, and $U^h(O_g(y))$ for $g'=a'$, condition (4) is automatically fulfilled given that O^*_{as}, $O^*_{a's'} = 0$, $\forall s \neq a$, $\forall s' \neq a'$. According to Section 2.2., the basic Baumol model can be defined by simply allowing (p.y) as U^j and ($\sum_i p_i y_i$), $y_i \geq 0$, as $U^h(.)$. It is instructive to mention that our procedure avoids a difficulty present in the usual equilibrium determination using the regular Lagrangean form and the Kuhn-Tucker conditions, namely, that these may be meaningful only for the case where $U^j(.) \geq \bar{U}^j$. When $U^j(.) < \bar{U}^j$, one would then have to assume that y=0 (see for example, KAFOGLIS

& BUSCHNELL, 1970). This is clearly, not in the spirit of Baumol's original discussion of the determinants of the minimum profit, which could be substantially larger than the competitive earnings to stockholders (see BAUMOL, 1959, p. 53).

The Yarrow model can be defined by letting $j=V(g,\xi)$ and $h=U(g)$, where V represents a firm's stock market valuation, $g=a...v$, corresponds to utility yielding decision variables and ξ is a vector of parameters that affect market valuation. The objective h is considered to be of first order whenever $V(g,\xi)^3V^*(\xi)$-C, where $V^*(\xi)$ is the maximum valuation and C is a parameter that represents enforcement costs.

Proposition 3 is directly applicable to this model provided we interpret correctly the meaning of Yarrow's g variables (or O_g, according to our notation). In other words, these correspond to decision variables in the sense of being under an entrepreneur's discretion in opposition to the exogenous character of the parameters ξ. Therefore, U(g) may still be a functional and y in Y represent the ultimate decision variables.

Without going into its details, one can consider Williamson's model to be formally in the spirit of Yarrow's model. The objective h is denoted a utility function with arguments given by variables reflecting expense preference, such as the excess expenditure on staff (S), the discretionary investment (I) and the company perquisites in excess of what would be necessary (M). Output may be taken as a common explanatory variable of S, I and M. On the other hand, j would be given by reported profits (which may differ from actual profits by the exclusion of profits in kind appropriated by managers).

One should also note that Williamson's as well as Yarrow's reference to objective h as a utility function, should not be taken to imply the existence of a real valued representation of a decision maker's overall preference relation on Y. Given its customary usage, the use of the term utility may perhaps, be inappropriate in this case.

3.2 *The Behaviorist Approach*

Behaviorism has been considered to be virtually irreconcilable with standard theory. In particular, it has been considered inconsistent with the idea of maximization of objectives. Attempts to reconcile both approaches by posing additional (concrete) objectives in a given managerial utility function have been criticized by authors such as Leibenstein (1979, p. 495) - such efforts would simply lead to non-falsifiable theories if, at the end, one would be led to conclude that "...*people behave as they do*."

Careful appraisal of those efforts shows that they may be flawed, in many cases, for other reasons. One can mention for example, that there are objectives that do not admit cardinal measurement. The preference for low effort intensity or for "better personal interaction" are examples of goals whose satisfaction can at most be represented according to an ordinal scale. This may preclude the definition of a given managerial utility function, in which those goals could not appear as explicit arguments (see note 2). On the other hand, as shown in section 2.1, specific utility functions displaying a functional form may be inconsistent with utility maximization with respect to the commodity space. One may stretch this argument even further and suggest that the existence of a meaningful utility functional would be questionable should the condition implied by equation (4) appear too restrictive for the managerial utility functions under consideration. In view of the analysis developed in section 1, it is then natural to suggest as a possible alternative method an approach based on the hypothesis of existence of multiple (irreducible) objectives. This has the benefit of allowing an ordinal measurement of goals, while it may enable one to eventually stick to a maximization framework, even in the absence of a well defined overall real valued objective function.

A key element in the behavioral approach is the notion of **satisficing** which is often substituted for the idea of maximization. In the remainder of this section I will discuss how the multiple objectives hypothesis may fare in an attempt to formalize the satisficing idea. Although the use of this concept has been criticized for its lack of a precise definition and of a convincing explanation for the determination of the aspiration levels (for example, see ELSTER, 1989) there has recently been a revival of interest (see for example, KARANDIKAR *et al.*, 1998) for updated references emphasizing applications in game theory). A significant effort is for example, Gilboa and Schmeidler's (1995) recent attempt of formalizing the satisficing idea as a byproduct of their "case-based decision theory". This suggestion was presented in a particular context of past experience based aspiration levels. On the other hand, it included the assumption of a well defined utility function. Incidentally, since Simon's early writings most researchers still discuss the satisficing and optimization notions in terms of the maximization of utility goal (for example, see KLEIN, 2001 and references therein).

In contrast, I will suggest that the consideration of multiple (irreducible) criteria represents a suitable basis in the provision of a formal foundation to the satisficing concept. This follows from Proposition 4 where it is shown that the satisficing notion implies the presence of multiple criteria, being thus, for this reason alone, inconsistent with the existence of a real valued representation of preferences and hence, incompatible with utility maximization.

We may start by observing that the idea expressed by the term "satisficing" as much as that revealed by the terms "maximizing" and "optimizing", carries a notion of voluntary action. Thus, Simon's needle searcher (see SIMON, 1987b, p. 244) may select a needle that is sufficiently sharp to sew with, rather than invest more effort and go after the sharpest needle in the haystack. Consider now the target setting models such as Baumol's. These can be related to the usual satisficing concept by allowing for multiple goals that are sorted out alternatively for maximization but only while corresponding aspiration levels are not met (see HAY & MORRIS, 1991, p. 290; see also DRAKOPOLOUS, 1994). It follows that a decision maker may simply **choose** not to maximize the satisfaction of a given criterion such as profit in the Baumol model. Revenue may be the maximand once profit reached a satisfactory level of accomplishment, with this criterion thus becoming of second rated importance.

In order to prepare the ground for a formal discussion of the satisficing idea let us imagine the production set Y' partitioned into three parts: a subset "**A**", containing fully known activities including already established routines (see NELSON & WINTER, 1982) for a detailed description of this concept); a subset "**B**", where the acquisition of relevant information and the deliberation about alternatives is feasible but costly in terms of the required effort; a subset "**C**", formed by alternatives that are such that the relevant information is impossible to obtain given a decision maker's cognitive limitations. Clearly, when the basic restriction is given only by decision time the identification of the subsets **B** and **C** may simply depend on the order chosen to acquire information about all alternatives.

With this simplified modeling design we will avoid an explicit reference to specific search patterns such as that corresponding, for example, to local adjustments around an initially prevailing position (see for example, de PALMA *et al.*, 1994 and SELTEN, 2001).

Irrespective of the searching procedure employed, the relevant point is that the satisficer's chosen position is not utility maximizing, although, according for example to Selten's analysis, it could be a local maximum. On the other hand, satisficing is not meant to represent utility maximization under some cognitive constraints (see for example, KLEIN, 2001 and SELTEN, 2001). Therefore, a satisficing alternative is not guaranteed to represent a utility maximizing element of the subset (**A+B**), even this being an available alternative (according also to SIMON's, 1987b definition of satisficing).[14] This also means the employment of a discretionary aspiration level which is lower than Klein's "best possible option". Notwithstanding an agent's possible ignorance about the precise effect of searching efforts, the usual analysis of the satisficing idea fo-

14 In a strict sense utility maximization implies the satisfaction of the completeness property. Note however, that according to KLEIN(2001, p. 118), optimization (which he takes as synonymous to utility maximization) could alternatively mean the selection of the best option; the best possible option or the best option given the available data.

cuses on a "satisficer's" choice behavior as if there existed a feasible alternative with a strictly higher utility level than that of the one ultimately selected. In other words, it is proposed that even if a decision maker knew that a yet (eventually) undisclosed alternative existed with a greater utility level, she might still settle for the first satisfactory alternative found in her process of search.

Proposition 4, showing that satisficing implies the existence of multiple (irreducible) criteria starts from the usual satisficing notion which implies the selection of a satisfactory but not utility maximizing alternative.

PROPOSITION 4. Consider a decision maker who satisfices with respect to criterion $j \in J$ at $y' \in Y'$. It follows that given $y^* \in Y'$, $y^* \neq y'$, such that $y^* \succ_j y'$, there is at least another criterion $h \neq j$ such that $y' \succeq y^*$. Therefore, there is no real valued representation of the agent's overall preference relation $\succeq$ on Y.

PROOF:

Assume that j is unique. Since we are assuming y' to be a satisficing alternative in Y' with respect to j it is not a maximal element with respect to $\succeq_j$ in $(\mathbf{A}+\mathbf{B}) \subseteq Y'$. This is in accordance with y' not being a maximal alternative under cognitive constraints. Hence, there is $y^* \in (\mathbf{A}+\mathbf{B})$, $y^* \neq y'$, such that $y^* \succ_j y'$. Since j is assumed unique, $\succeq_j = \succeq$ and hence $y^* \succ y'$. Thus, these two alternatives fulfill the comparability property. Given that y' was chosen in Y' as a satisficing alternative it follows that $y' \succeq y^*$, a contradiction. Therefore, there is at least another criterion $h \in J$, $h \neq j$, fulfilling $y' \eqsim_k y^*$, $k=1...m$, $m>1$ or of the Gth importance ranking at y' or at y* and such that $y' \succ_G y^*$, given $y' \eqsim_k y^*$, $k<G$, implying $y' \succeq y^*$. The existence of h in addition to j must follow given that $y' \succeq y^*$ and $y^* \succ_j y'$. Therefore, the continuity condition of $\succeq$ on Y is not fulfilled and $\succeq$ has no real valued representation on Y.

There are cases such as the Baumol type models whose main features may be described adequately by simply letting $Y'=\mathbf{A}$ and assuming that the subsets **B** and **C** are empty. In other words, these are instances where one could eventually treat the satisficing notion without introducing such aspects as incomplete information and deliberation costs (see CONLISK, 1996 for a detailed description of this concept). Thus, one could thereby eventually stay in the domain of full rationality (preserving the completeness condition besides the transitivity restriction).

As mentioned above, discovering a greatest alternative $\hat{y}^*$ with respect to a given objective j may require a certain effort which at its extreme may be infinitely large. The satisficing alternative y' may be chosen because the importance of j (for example, profit) or for example, of a minimization of effort goal h, is smaller or equal at y' than the importance of h at $\hat{y}^*$. If h is prominent at y', no increase in effort would be tolerated by the decision maker, no matter its magnitude or the size of its return in terms of the profit objective.

Proposition 4 implies the possibility of formalizing the satisficing concept making explicit the presence of multiple goals:

Definition 3. An objective $j \in J$ predominant at a given point $y' \in Y'$ or in its neighborhood[15], has reached a **satisficing degree of accomplishment** at y', if there is $Y^* \subset Y'$, $Y^* \neq \varnothing$, with $y^* \in Y^*$ fulfilling $y^* >_j y'$ and such that one of the following cases is in effect:

A) there is $h \in J$, $h \neq j$, of the Gth importance order at y'or at y*, $G \geq 1$, such that $y' >_G y^*$, given $y' \cong_k y^*$, $k < G$;

B) $y' \cong_k y^*$, $k = 1 \ldots m$, $m > 1$.

The satisficing notion is thus defined in terms of a specific goal in a multiple objectives setting. It is in fact difficult to understand the notion of satisficing of a criterion such as profit, meant as a voluntary act, without having another goal, such as for example lower effort or revenue, as a counterpart. This is not inconsistent with Simon's own description of the

15 Note that j may eventually be of second rated importance at y' but prominent in its neighborhood, if the criteria's ordering is discontinuous at y', such as in the Baumol type models (see Corollary 3).

satisficing principle, often worded in terms of a plurality of goals and where the effort criterion is sometimes placed as a reference with respect to the determination of the aspiration levels of other objectives. (SIMON, 1987b)[16] One may also note that Selten's **aspiration adaptation theory** is formulated as an explicit multi-goal problem. (SELTEN, 2001, p. 18)

It is an implication of our model that the meaning of the "aspiration level" concept may depend on the fulfillment of the axiom A_3', which implies a continuous ordering of goals. According to Corollary 3 below, when A_3' is satisfied, "aspiration level" could be a superfluous notion when compared to "satisficing degree". The satisficing measure of a given criterion (or its aspiration level) could then be determined endogenously in contrast to the exogenous character of most descriptions of the aspiration level idea. While for example, in Gilboa and Schmeidler (1995) a change in an agent's aspiration level is equivalent to a shift of the utility function and thus, of preferences, assuming A_3' a change in the satisficing level of a given criterion may be due to a shifting parameter. For example, it is easy to see that a reduction in a firm's cost may increase its satisficing level of profit (and of revenue) for a continuous ordering of these goals.

A direct consequence of Proposition 4 is the fact that a pre-determined aspiration level of a given criterion, such as given by $\bar{U}^j$ in the target setting models[17] of Proposition 3, implies a discontinuous ordering of goals at a satisficing alternative and hence the violation of A_3':

16 This interpretation is also consistent with the passing reference given to the satisficing notion by other authors (see for example, SEN's (1997, p. 768) allusion to the profit goal in opposition to "other priorities", in his own description of this concept). Simon specified the satisficing degree of achievement of a given goal in terms of an adjustable aspiration level. This is assumed to move in either direction in terms of an intuitive idea of ease or difficulty to reach a provisionally chosen aspiration level. Clearly, we have here an implicit notion of effort playing the role of another, competing for fulfillment goal.

17 Recall that according to our analysis in section 2, a given aspiration or target level could in this case be established in terms of any of the arguments of U(.)

COROLLARY 3. Assume that y' is a satisficing alternative of a criterion j in Y' given a pre-determined aspiration level $\bar{U}^j$. It follows that there is at least another goal h≠j prominent at y' and such that these criteria's ordering is discontinuous at y'.

PROOF:

The requirement $U^j(y')=\bar{U}^j$ for y' being a satisficing alternative of j in Y' imposes upon a decision maker's preference relation the restriction that j be predominant in $\hat{Y}$ = y∈Y: $U^j(y)<\bar{U}^j$ and another goal h being prominent in $\tilde{Y}$ =y∈Y: $U^j(y)\geq\bar{U}^j$. Therefore, to prove that $A_3^{'}$ (the property of continuity of the criteria's ordering) does not hold at y', there remains the task to show that there is no point in Y where j has the same importance as h at y'.

If $\succeq_j$ satisfies the continuity restriction A_3, the condition above implies that A_3 is not fulfilled by $\succeq_h$ when considering the entire set Y, being nonetheless, eventually satisfied in $\tilde{Y}$ and in a closed subset of $\hat{Y}$. In order to clarify this point let us take y* in $\hat{Y}$ such that $|y'-y^*|<\varepsilon$, where $\varepsilon>0$ is arbitrarily small. Since at y' j's aspiration level has been reached, j will be of second rated importance at this point, while being the only first ranking criterion at y*. Thus, while j and h will not attain the same importance at y' it follows that no matter how small the value of ε, $|U^h(y')-U^h(y^*)|=\delta$ will not tend to vanish.

Clearly, the aspiration level $\bar{U}^j$ will affect the agent's preference relation ≽ in such a manner that ≽ will not impose a precisely determined value for δ and hence, for $U^h(y')$. It follows that according to (1) in subsection 1, h has not a well defined importance level at y' and thus, there is no alternative in Y such that j may have the same importance as h at y'. This completes the proof that $A_3^{'}$ will not be fulfilled at y'.

Changes of the aspiration level may then carry the same meaning as in Gilboa and Schmeidler (1995), representing a shift in preferences. In the present paper these changes also mean that there is a shifting point of discontinuity in the ordering of objectives. In this case we have a meaningful aspiration level that could be entered in place of the condition A_3' to complete the definition of a particular overall preference relation.

This view of satisficing, based on a more general model of choice, leads us to the point that even admitting concepts developed in the so called behavioral mode of analysis, one can in some cases, still employ an optimizing framework to determine a firm's chosen activity. For example, maximizing the satisfaction of the first ranked objective, may be consistent with the attainment of only a satisficing degree of accomplishment of the goals represented in this example by profit and revenue.[18] It is also an implication of the present analysis that the consideration of multiple objectives may eventually reduce the prevalence of bounded rationality by allowing the concept of full rationality to be extended beyond the notion of utility maximization.[19]

4. *SUMMARY AND CONCLUDING REMARKS*

In this paper I examined the possible role of multiple objectives in the analysis of the firm. Strictly speaking, this would mean a reference to multiple **irreducible** objectives. I employ the lexicographic principle as an ordering mechanism of alternatives to deal with the possibility of multiple irreducible goals. The existence of multiple arguments in a mana-

18 Note that in a Baumol type model, satisficing may be reached only with respect to a single criterion at a time. This follows from the discontinuity in the objectives' ordering at the satisficing alternative. This also explains the absence of a real valued representation of the first ranked criterion.

19 I am referring to the usual interpretation of bounded rationality based on a narrow definition of rationality given in terms of utility maximization (see CONLISK (1996) for a survey on Bounded Rationality). A distinct definition of rationality (and thus, of bounded rationality (see also RADNER (1996) on the notion of truly bounded rationality)) which is adopted in this paper (see for example, MAS-COLELL *et al.* (1995)) is given by the completeness and transitivity of $\succeq$ on Y.

gerial utility function is acknowledged by the use of the concept of **concrete goals**, meant to be reducible in terms of a common denominator. In this paper I stress the point that special attention is due to the fact that the utility functions of the firm display in general the form of a functional, where multiple arguments are themselves functions of decision variables generally defined in the commodity space. A question was posed about the necessary conditions for a given utility functional to be the real valued representation of an entrepreneur's preference relation defined in the commodity space.

A main result of this paper is the suggested answer, showing that the subjective conversion factors between the arguments of a given utility functional include subjective equivalence weights that must be such that the effects of their rates of change with respect to a given commodity cancel out. Considering for example, the often found instances where a firm's utility functional has only two arguments, this condition (equation (4) in subsection 2.1.) implies that these be independent in the sense that the change in one of them would not affect the other's subjective conversion factor with respect to it (or loosely speaking, its intrinsic or subjective "value").

Considering typical pairs of arguments such as profit and leisure or profit and a firm's market share, the research that is needed to support or reject the independence condition is beyond the scope of this paper. In any case, this condition was shown to be restrictive enough so as to prevent the use of Cobb-Douglas type utility functions. Future work may be devoted to investigate further the restriction imposed by equation (4) with respect to the precise form of the utility functionals. One may suspect that the restrictiveness implied by that condition is greater the smaller the number of their arguments. It is to be expected that with an increasing number of arguments there might be a sharp increase in the number of their corresponding complementarity or substitutability relations that may validate condition (4).

This result can possibly be extended to at least part of the widespread uses of utility functionals throughout the economics literature, including cases outside the theory of the firm. A direct application corresponds to the **target setting** models such as Yarrow's and Williamson's where there is at least one criterion which is a functional with multiple arguments. The condition (4) mentioned above will represent one of the necessary requirements for the existence proof of an equilibrium. Another necessary condition is the weak continuity restriction used in this paper and which must be imposed on each of the irreducible criteria.

A byproduct of my analysis is the proposal of an extensive form for an agent's utility function. This allows us to convert the ordinal measure of the abstract utility representation into a cardinal measure which is necessarily displayed by any of the concrete goals in terms of which the agent's preferences may then be represented. The use of a utility function in its extensive form may allow one to make explicit in the definition of each function δ_{rs} (y) $r,s=a...v$, corresponding to the subjective equivalence weights, a feasible relationship between the concrete objectives $g=a..v$, so as to fulfill equation (4).

The existence of multiple irreducible goals is consistent with Dutta and Radner's (1999) result that most firms that survive in the long run are not profit maximizers. Given that the probability of survival varies directly with profit, and thus, indirectly with profit's relative importance, survivors would tend to maximize other goals. It also follows from this argument that firms with a low or even negative profit string would be more disposed toward maximizing profit, which would then tend to be their prominent objective. Clearly, these are also the firms most likely to fail, an implication also consistent with this other conclusion by Dutta and Radner.

If an agent chooses not to maximize profit or utility, the idea of optimization may still represent more than a mere tautology if one realizes that this outcome may simply reflect the presence of multiple goals and the consequent absence of a real valued (utility) representation of preferences. Eventually consistent with a broad view of rationality, not restricted to utility maximization, one may observe a satisficing behavior with respect to a given criterion in a multi-goal setting. In what I believe to be a novel finding, it was shown that the satisficing idea is only applicable given the existence of multiple objectives, also acknowledged the possibility of incomplete information.

An exogenously given aspiration level of a given criterion was shown to imply that our model's property of continuity of the ordering of objectives will remain unfulfilled at the corresponding satisficing activity. This is the case in the **target setting** or Baumol type models, where changing target values may correspond to varying preferences and shifting points of discontinuity in the ordering of goals. A significant research agenda may perhaps include a study of evolving aspiration levels with a separate analysis of those displaying an endogenous nature and of those exhibiting an exogenous character, respectively associated to a continuous and discontinuous ordering of goals at the satisficing activity.

REFERENCES

ALCHIAN, A. Uncertainty, evolution and economic theory. *Journal of Political Economy,* v. 58, p. 39-53, 1950.

ARROW, K. J. Invaluable goods. *Journal of Economic Literature*, v. 35, p. 757-765, 1997.

AUSTER, R. D.; SILVER, M. Comparative statics of the utility maximizing firm. *Southern Economic Journal*, v. 42, p. 626-632, 1976.

BAUMOL, W. J. On the theory of oligopoly. *Economica,* v. 25, p. 187-198, 1958.

______. *Business behavior value and growth.* New York: The Macmillan Co., 1959.

BROWN, M.; REVANKAR, N. A generalized theory of the firm: an integration of the sales and profit maximization hypothesis. *Kyklos*, v. 24, p. 427-443, 1971.

CONLISK, J. Why bounded rationality? *Journal of Economic Literature*, v. 34, p. 669-700, 1996.

CYERT, R. M.; MARCH, J. G. *A behavioral theory of the firm.* 2nd ed. Cambridge, Mass.: Blackwell, 1992.

DE PALMA, A.; MYERS, G. M.; PAPAGEORGIOU, Y. Y. Rational choice under an imperfect ability to choose. *American Economic Review,* v. 84, p. 419-440, 1994.

DRAKOPOLOUS, S. A. Hierarchical choice in economics. *Journal of Economic Surveys*, v. 8, p. 133-153, 1994.

DUTTA, P. K.; RADNER, R. Profit maximization and the market selection hypothesis. *Review of Economic Studies*, v. 66, p. 769-798, 1999.

ELSTER, J. *Solomonic judgments. Studies in the limitations of rationality.* Cambridge: Cambridge University Press, 1989.

ENCARNACION, J. JR. Constraints and the firm's utility function. *Review of Economic Studies*, v. 32, p. 113-120, 1964.

______. Consumer choice of qualities. *Economica*, v. 44, p. 63-72, 1990.

FERSHTMAN, C.; JUDD, K. L. Equilibrium incentives in oligopoly. *American Economic Review*, v. 77, p. 927-940, 1987.

FRIEDMAN, M. *Essays in positive economics.* Chicago: University of Chicago Press, 1953.

FORMBY, J. P.; MILLNER, E. L. The convergence of utility and profit maximization. *Southern Economic Journal*, v. 51, p. 1174-1185, 1985.

GEORGESCU-ROEGEN, N. Choice, expectation and measurability. *Quarterly Journal of Economics*, v. 68, p. 503-534, 1954.

______. Utility. *In*: SILLS, D. H. (ed.), *International Encyclopedia of The Social Sciences*, v. 16, p. 236-267. New York: Macmillan Co., 1968.

______. *The entropy law and the economic process*. Cambridge, Mass.: Harvard University Press, 1971.

GILBOA, I.; SCHMEIDLER, D. Case based decision theory. *Quarterly Journal of Economics*, v. 110, p. 605-639, 1995.

HAMMOND, P. J. Equity, Arrow's conditions, and Rawls's difference principle. *Econometrica*, v. 44, p. 793-804, 1976.

HANNAN, T. H. On the equivalence of profit maximization and utility maximization by an owner-manager: comment. *Southern Economic Journal*, v. 49, p. 255-259, 1982.

HAY, D. A.; MORRIS, D. J. *Industrial economics and organization - theory and evidence.* 2nd ed. New York: Oxford University Press, 1991.

HERSZTAJN MOLDAU, J. A model of choice where choice is determined by an ordered set of irreducible criteria. *Journal of Economic Theory*, v. 60, p. 354-377, 1993.

HOLMSTROM, B. R.; TIROLE, J. The theory of the firm. *In*: SCHMALENSEE, R.; WILLIG, R. D. (eds.), *Handbook of industrial organization.* V. 1, p. 61-133. Amsterdam: North-Holland, 1989.

KAFOGLIS, M. Z.; BUSCHNELL, R. C. The revenue maximization oligopoly model: comment. *American Economic Review*, v. 60, p. 427-434, 1970.

KARANDIKAR, R.; MOOKHERJEE, D.; VEJA-REDONDO, F. Evolving aspirations and cooperation. *Journal of Economic Theory,* v. 80, p. 292-331, 1998.

KLEIN, G. The fiction of optimization. *In*: GIGERENZER, G.; SELTEN, R. (eds.), *Bounded rationality*: the adaptive toolbox. MIT Press, 2001, p. 103-121.

LANDSBERGER, M.; SUBOTNIK, A. Optimal behavior of a monopolist facing a bicriteria objective function. *International Economic Review*, v. 170, p. 581-600, 1976.

LEIBENSTEIN, H. A branch of economics is missing: micro-micro theory. *Journal of Economic Literature*, v. 17, p. 477-502, 1979.

MAS-COLELL, A.; WHINSTON, M. D.; GREEN, J. R. *Microeconomic theory.* New York: Oxford University Press, 1995.

MILLER, S. M.; ROMEO, A. A. Alternative goals and uncertainty in the theory of the firm. *Southern Economic Journal*, v. 46, p. 189-205, 1979.

NELSON, R. R.; WINTER, S. G. *An evolutionary theory of economic change*. Cambridge, Mass: The Belknap Press of Harvard University Press, 1982.

OLSEN, E. O. Profit maximization vs utility maximization: a correction. *Southern Economic Journal*, v. 43, p. 1390-1393, 1977.

PIRON, R. Utility maximization sufficient for competitive survival: comment. *Journal of Political Economy*, v. 82, p. 654-656, 1974.

RADNER, R. Bounded rationality, indeterminacy and the theory of the firm. *Economic Journal*, v. 106, p. 1360-1373, 1996.

RAWLS, J. *A theory of justice.* Cambridge, Mass.: Harvard University Press, 1971.

ROSENBERG, R. Profit constrained revenue maximization: note. *American Economic Review*, v. 61, p. 208-209, 1971.

SAMUELSON, P. A. Complementarity - an essay on the 40th anniversary of the Hicks-Allen revolution in demand theory. *Journal of Economic Literature*, v. 12, p. 1255-1289, 1974.

SCITOVSKY, T. A note on profit maximization and its implications. *Review of Economic Studies*, v. 11, p. 57-60, 1943.

SELTEN, R. What is bounded rationality? *In*: GIGERENZER, G.; SELTEN, R. (eds.), *Bounded rationality*: the adaptive toolbox. MIT Press, 2001, p. 13-36.

SEN, A. Entry and managerial incentives. *International Journal of Industrial Organization*, v. 11, p. 123-137, 1993.

SEN, A. K. Social choice theory. *In*: ARROW, K. J.; INTRILIGATOR, M. D. (eds.), *Handbook of mathematical economics*. V. 3, p. 1073-1181. Amsterdam: North Holland, 1986.

_______. Maximization and the act of choice. *Econometrica*, v. 65, p. 745-779, 1997.

SIMON, H. A. A behavioral model of rational choice. *Quarterly Journal of Economics*, v. 69, p. 99-118, 1955.

_______. Theories of decision making in economics and behavioral science. *American Economic Review*, v. 49, p. 253-283, 1959.

_______. *Administrative behavior*: a study of decision making processes in administrative organization. 30. ed. New York: Free Press, 1976.

_______. Rational decision making in business organizations. *American Economic Review*, v. 69, 493-513, 1979.

_______. Bounded rationality. *In*: EATWELL, J. *et al.* (eds.), *The new palgrave, a dictionary of economics*. London: Macmillan Press, 1987a.

_______. Satisficing. *In*: EATWELL, J. *et al.* (eds.), *The new palgrave, a dictionary of economics*. London: Macmillan Press, 1987b.

SKLIVAS, S. D. The strategic choice of managerial incentives. *Rand Journal of Economics*, v. 18, p. 452-458, 1987.

UZAWA, H. Preference and rational choice in the theory of consumption. *In*: CHIPMAN, J. *et al.* (eds.), *Preferences, utility and demand*. New York: Harcourt Brace Jovanovich, 1971, p. 7-28.

WILLIAMSON, O. *The economics of discretionary behavior.* Chicago, 1967.

YARROW, G. On the predictions of the managerial theory of the firm. *Journal of Industrial Economics*, v. 24, p. 267-279, 1976.

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