



# Rational behavior and economic theory

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## Abstract

Nowadays, it seems almost universally presumed that the fundamental characteristic of *homo oeconomicus* is his rationality. We analyze the role played by the concept of rationality in economic theory, and demonstrate that it is necessarily constrained to be an essentially contentless notion. We show that the main body of economic theory is firmly grounded, and that some contrasting approaches to rationality, although leading to heated debates and vivid confusion, have no fundamental significance for economics. With a refreshed view on the essence of economics, we argue that the principles of economic theory form an essential methodological guide for the emergent line of research based on the use of so-called 'evolutive' models.

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## 1. Introduction

One of the main tasks of economic theory is to explain the outcomes of a decentralized economy. Since Smith (1776), the dominant questions with which economic theory is occupied concern the working of 'the invisible hand', or the process of interaction of many individual agents in a decentralized economy. As it is almost unquestionable that the point of departure of economic analyses is *homo oeconomicus*, and it would seem to be universally accepted that the fundamental

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characteristic of *homo oeconomicus* is, or should be, his *rationality*, it is very important to have a clear and unambiguous understanding of what we mean by this. And, in fact, the essential issue appearing in many recent debates in economics, is the notion of *rationality*.

The assertion that '*economics is what economists do*', attributed to Viner (see Boulding, 1966), is usually considered to be rather ludicrous. However, some recent epistemologic insights, largely documented in Samuels (1990), have made clear that while Viner's phrase was maybe somewhat too condensed, it did hit the nail on the head. Updated it could be rephrased as approximately the following: '*Economics are the as such acknowledged discourses of those who are in turn considered economists*'. Not every given discourse is intended as economics, nor does every aspiring economist succeed in inserting his discourse into the ongoing economic discourses. Both contents and form must fulfil certain qualitative requirements that determine what falls into the domain of economics, and which are themselves subject to change in the unfolding of discourses. Therefore, in section 2 we will analyze what economists do.<sup>1</sup> We will look for constants in the discourses of those who are generally considered to be mainstream economists, in order to discover their underlying common grounds. It is only with the thus set forth fundamentals of economic theory, that one can put the notion of rationality in economics in its right place. Hence, we will argue that the fundamental conception of rationality in the economics literature is the '*pursuance of self-interest*'.

If the thus stated economist's point of view on the notion of rationality is accepted, then there are two serious consequences. First, as will be shown in sections 3 and 4, two alternative approaches to rationality, i.e., '*internal consistency of choices*' and '*reasonableness of decision-making procedures*', although leading to confusion and heated debates, have no fundamental significance for economics. Certainly, insights from philosophers, psychologists, computer-scientists, game-theorists, statisticians, or biologists are often very clarifying and helpful, but alternative approaches to rationality should not simply be presented as to be taken for granted, even in economic journals, when in fact these may be irreconcilable a priori with the economic approach. Thus, while Sugden (1991), after having examined what he considers to be the foundations of rational-choice theory, concludes that these are rather shaky and that therefore '*{e}conomic theorists have to become as much philosophers as mathematicians*' (p. 783), we will argue that economic theorists should be economists in the first place. The second serious consequence concerns the modeling of a decentralized economy. With a clarified understanding of the basic issues that lie at the heart of economics, in section 5, we will argue that the principles of economics form an

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<sup>1</sup> This is not necessarily the same as what they themselves would declare in a methodological account of their work; nor are they themselves necessarily consistent in this respect.

essential methodological guide for the emergent line of research based on the use of so-called ‘*evolutive*’ models.

## 2. Economics and rationality: Self-interest

It is widely accepted that the science of economics started with Adam Smith. The main accomplishment of Smith was to put forward as the central theme of economics the systematic analysis of the behavior of individual agents pursuing their self-interest under conditions of competition. The most eloquent quotation in this respect is presumably: ‘*It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest*’ (Smith, 1976, p. 26/27). Since then, this axiom concerning the behavior of individual agents has become, as a matter of course, a fundamental feature of economic discourses.<sup>2</sup> A century later Edgeworth (1881) considered it useful to state this point explicitly and with great precision: ‘*The first principle of Economics is that every agent is actuated only by self-interest*’ (p. 16). To appreciate this assertion of Edgeworth fully, it may be necessary to examine this compound statement very carefully.

The second part asserts something about individual agents that echoes Smith. The ultimate motive for any action must be found in the agent’s desire, i.e., agents act only out of self-interest. This presupposes that it is evident what is meant by the term *self-interest*. Edgeworth (1881), more than a century ago, used the word ‘*pleasures*’, defined as ‘“*preferable feeling*” in general’ (p. 56). In the language of present-day economic discourses, self-interest is defined as a matter of *preferences*. Next, let us consider the first part of Edgeworth’s assertion. He claims that this is the first principle, the starting-point, of economics. In other words, the statement about individual agents motivated exclusively by self-interest is a defining statement concerning *homo oeconomicus*. *Homo oeconomicus* is an agent with given preferences, pursuing his self-interest, seeking to do the best he can given his opportunities.

Modern, mathematical general equilibrium theory is apparently rather distinct from classical and neoclassical economics. Without doubt, the principal discourse in this field is that of Debreu (1959). This study in pure theory is sometimes called a *piece of art* because it is such an elegant and self-contained work. Nevertheless, Debreu has been very careful to accurately insert it into the discourse of economics, as ‘*an agent is characterized by the limitations on his choice, and by his choice criterion*’ (p. 37). In other words, it is opportunities and preferences that play the basic role. Remarkable is the fact that the notion *rationality* does not

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<sup>2</sup> Whether this was how Smith himself actually intended to put these matters is an interesting, but *different*, question (see e.g. Holmes, 1990).

appear once in Debreu (1959). Also in this sense Debreu (1959) fits almost seamlessly into the economic tradition, as the notion of *rationality* was practically non-existent in classical and neoclassical economic discourses. According to Arrow (1986), '[i]t was really not until the last 30 years that it has been used systematically as an economic explanation' (p. S390). It was, above all, the 'Chicago School' tradition (e.g., Friedman, 1953; Stigler, 1961; Baumol and Quandt, 1964; Becker, 1957; Becker, 1964; Lucas, 1972; Riker and Ordeshook, 1973) with which most people would come to associate this notion.

It was when the latter began to develop the economic line of argument further, encompassing phenomena previously neglected by economics, combined with the systematic use of standard mathematical techniques, that the notion of rationality began to appear explicitly in economic discourses increasingly frequently to label the behavior of *homo oeconomicus*. Readers familiar only with the current literature may be surprised at the scarce and hesitating use made of the term rationality in the mentioned early discourses in this tradition. For example, Friedman and Savage (1952), Friedman (1953), Stigler (1961) or Baumol and Quandt (1964) use the term rational only once or twice, and in very insignificant places. Instead of rational or irrational they use notions as 'wise' or 'perverse'.<sup>3</sup> We will now illustrate that this 'Chicago School' approach to human behavior is a further articulation or deepening of the economic approach only, and does not form a break with the classical or neoclassical tradition.

A first important exposition is that of search theory, for which the stage in economics was set by Stigler (1961). The typical case considered in search theory is approximately the following: A consumer wants to buy a unit of a certain commodity.<sup>4</sup> Clearly, he prefers to do so at the lowest available price in the market. Unfortunately, he does not perceive all ruling prices with certainty, and there are costs (money, time, disutility) attached to actions that improve the perception of his transaction opportunities, i.e., searching for lower prices. Both the returns of search in the form of lower prices and the costs of search will also depend on the consumer's preferences. Economic behavior implies that a consumer does search, and thus does change his perspective on his opportunities, as long as he perceives this to be advantageous to him. As a result, agents do not necessarily buy at the lowest price available in the market, but at the lowest price they perceive in their opportunity set, while better opportunities might be available 'just around the corner'.

Stigler (1961) is usually referred to as the first paper in search theory in economics. The pretended meaning of Stigler's discourse is however much more general, and he considers the question of search merely one example. As Stigler

<sup>3</sup> It be interesting to trace back the usage of the notion of rationality more exactly, applying modern techniques that permit quantitative text analysis.

<sup>4</sup> Clearly, if he cannot buy below a certain threshold level, he will certainly not buy at all.

(1961) put it: '*our understanding of economic life will be incomplete if we do not systematically take account of the cold winds of ignorance*' (p. 224). In fact, Stigler (1961) rehabilitates all ignorant people, by making a conceptual distinction between ignorance and irrationality.<sup>5</sup> The point is, in brief, that information is a valuable asset. Hence, the information that an individual agent has, in particular his perception of opportunities, is the result of economic behavior. Ignorance is an economic phenomenon, while irrationality is not!

Since Stigler (1961), a rich search literature has developed, which has focused almost exclusively on the issue of the objectively optimal search strategy.<sup>6</sup> Clearly, this depends on the assumptions made by defining the institutional setting and the agents' environment. However, one of the conclusions to draw from Stigler (1961) is that these discussions concerning optimal strategies are of only relative importance. Just as rational agents do not in general buy at the lowest price available in the market, they will normally not search following the objectively best strategy available in their environment.<sup>7</sup> Thus, the articulation introduced by Stigler (1961) in economics is the explicit attention given to the consumers' opportunities and their perception of these opportunities, and to the fact that these perceptions themselves depend on economic behavior.

A second clarificatory discourse is that of human capital theory (e.g., Becker, 1964). Human capital theory handles earnings functions that relate the following three variables to each other: investment in *human capital*, the rate of return on these investments, and the resulting income. Although, a priori, it is not clear which variable should be explained by the other two, much empirical effort has been put into estimating ex post differences in rates of return. These differences are the net effect of all those factors that cause possibilities and capacities to be different for individuals. That is, market imperfections, uncertainty, genetic factors and social background; in short, perceived opportunities. This has led to the

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<sup>5</sup> '*Ignorance*' covers both cases of risk and uncertainty. The '*traditional*' appraisal of Knight (1921), according to which one can distinguish situations of risk in which one can attach probabilities to a number of outcomes and situations of uncertainty in which this is not possible, suggests that there may be different degrees of ignorance of the individual agent. However, a more recent interpretation of Knight (e.g., LeRoy and Singell (1987)) recognizes that it is always possible to assign subjective probabilities to every conceivable event. The difference between risk and uncertainty is that risk can be insured or hedged, while this is not possible with uncertainty because relevant events are not objectively (i.e., publicly and cheaply) verifiable, leading to '*modern*' problems such as adverse selection and moral hazard.

<sup>6</sup> While Stigler (1961) considered fixed sample size search, later papers, e.g. McCall (1965), argued that sequential search is the optimal strategy, and Morgan and Manning (1985) showed that a combination of both may be still better.

<sup>7</sup> Some have argued (see e.g., Elster, 1986) that when an agent is ignorant as to what the benefits of a certain action might be, he has no grounds to decide whether to choose that action. This point resembles a well-known discussion in expected-utility theory, concerning the (im)possibility to assign probabilities to certain imaginable events. It now seems almost universally recognized that agents are always able to choose between 'lotteries'. The reply to the ignorance problem would be analogous.

criticism (see e.g., Arrow, 1986) that the differences in rates of return cannot be explained by the two central concepts of human capital theory: the existence of a homogeneous production factor *human capital*, and the rationality of individual behavior. Instead, human capital theory is said to rely completely on auxiliary hypotheses.

The more specific contribution to economics by human capital theory is the recognition that not only information is a valuable asset, but also the development of cognitive skills is a result of economic behavior. Apart from this specific articulation of economic discourses, human capital theory is merely one example of a series of discourses in which the economic approach is applied to very diverse areas of human behavior, even in apparently surprising ones as crime and passion (Becker, 1968; Becker, 1973). To support this approach it was emphasized that in these analyses the individual agents behaved rationally. The discussions around this issue makes the significance of the economic approach very clear. Simon (1986) in discussing Becker (1981) states: '*... the conclusions that are reached by neoclassical reasoning depend very much on the "auxiliary" factual assumptions that have to be made to define the situation and very little on the assumption of rationality*' (p. S212). Lucas (1977) observes: '*Even psychotic behavior can be (and today, is) understood as "rational" given a sufficiently abnormal view of relevant probabilities*' (p. 15).<sup>8</sup> And Arrow (1986) on the rationality hypothesis: '*... its apparent force only comes from the addition of supplementary hypotheses*' (p. S389).

The crucial point to be made is the following. These observations are correct, in the sense that they indicate precisely the essential characteristic of the economic approach.<sup>9</sup> The Chicago School has never introduced rationality as a new, powerful, independent explanatory factor in economic models. Becker (1976) is very frank and explicit here: '*When an apparently profitable opportunity ... is not exploited, the economic approach does not take refuge in assertions about irrationality ... Rather it postulates the existence of costs, monetary or psychic, of taking advantage of these opportunities that eliminate their profitability – costs that may not be easily "seen" by outside observers*' (p. 7). Rational behavior is simply another name for economic behavior; a question of rhetorics. Rationality in economics means that an individual agent chooses (one of) the most advantageous options, given his preferences, in his perceived opportunity set.

Here, opportunities are defined such that *all* perceived costs and benefits are taken into account; in particular, information, decision-making and transaction

<sup>8</sup> Hence Lucas' argument for the Rational Expectations Hypothesis, about which we will say more in section 5.

<sup>9</sup> This does not imply that one necessarily has to agree, for example, with Becker (1968) on crime, even as an economist. The point, however, is that this can be, not on account of his rationality assumption, but only because one does not agree with the assumptions he has made in his models, concerning the agents' preferences and perceived opportunities.

costs (see Day, 1964). These subjective perceptions are sometimes called '*beliefs*' or '*expectations*'. Perceived opportunities are perceived possible actions plus perceived consequences. Opportunities are not necessarily only transaction opportunities. Agents may also have possibilities to search, talk with a friend, go to school or to the beach, do nothing, etc. As perceived opportunity sets will never be empty, each agent will always in all circumstances be able to choose a most preferred action. Hence, in every situation there exist rational choices.<sup>10</sup>

While *homo oeconomicus* is an agent with *given* preferences, some might argue that in reality preferences are not at all given, and may be subject to frequent changes. However, the Lancasterian approach to preferences, not for final goods but for characteristics, makes the economic approach quite '*stretchable*' in this respect (Lancaster, 1966). More important is the observation that the possibility of changing preferences is an issue that goes not only beyond the scope of economics, but would also be inconsistent with it. If preferences were flexible, then the concept of *self-interest* would no longer be defined. The reason is that in this case, the agents' own actions might influence their future preferences, or they might at least want to find out whether and how they could do so. In order to value such actions, agents must have meta-preferences, i.e., preferences about their own preferences. Two approaches to such meta-preferences are possible. Either one assumes that these form a given underlying structure, or one assumes that they might change as well. The former point of view would be consistent with the economic approach (see e.g., Becker, 1991), while the latter would lead to an infinite regress, as the agents should have preferences about their meta-preferences, etc.

Thus, what is really fundamental in economic theory are preferences and perceived opportunities. Clearly, by relating the notion of rationality in economics in this way to the pursuance of self-interest, one has '*emptied*' the notion of rationality of all substance. The merit of the Chicago School is that they have made this point so clear. Pushing the logic of economics to its limits, and following its line of argument consistently into every conceivable corner of social events, they have demonstrated that the rationality postulate is necessarily constrained to be essentially contentless in economics.

In this way, a number of issues in economics is straightaway put deliberately beyond discussion in economics, as Edgeworth's assertion previously made clear. The only possible way to make rationality play an independent, explanatory role with respect to economic behavior would be to neglect completely the importance of given preferences and perceived opportunities, but this would imply giving up the foundations of economics. As calling economic behavior '*rational*' has led to much senseless confusion in economics, it may be more appropriate to call *homo*

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<sup>10</sup> Cf., Elster's rationality critique, where it is argued that there are situations in which rational choices simply do not exist (Elster, 1983).

oeconomicus 'opportunistic', acting always in accordance with his incentives. It is this latter formulation that Aumann (1985) calls '*the most important and fundamental idea of economics*' (p. 43). Note that opportunistic behavior is *not* the opposite of commitment-seeking behavior. Economic behavior implies that an agent seeks commitment whenever he perceives this to be opportune.

In the remainder of this section we will illustrate the meaning of the economic approach further by discussing six misdirected criticisms that has been brought to bear against it, and by explaining that the economic approach is restrictive only in one very specific sense.

First, a criticism is that by postulating that all actions of economic agents are rational, one has obtained a '*remarkably mute theory*' (Sen, 1978, p. 30). However, the behavior of the individual agent is not the *explanandum* of economics. On the contrary, the rational individual agent, taking into account his preferences and perceived opportunities, is the *explanans* of economic theory. The substantive interest of economists is in the aggregate outcomes of the interactions of many of these agents, in the working of the system.

Second, some have argued that focusing upon self-interest implies an overly narrow view of human behavior because agents may, and indeed sometimes do, show altruism (see Mansbridge, 1990 for a survey). However, this is not contended by the economic approach to human behavior. One should not confuse self-interest with egoism. When an agent happens to have altruistic preferences, it is certainly in his self-interest to act altruistically. There have sometimes also been discussions in which self-interest has been confused with the well-being of the agent's own body. To this the same reply as above applies (see e.g., Hammermesh and Soss, 1974). As Hayek (1948) argues, more important is not the question whether an economic agent is completely selfish or the most perfect altruist, but the fact that the things for which he can effectively care are an almost negligible fraction of those of all members of society. '*The real question, therefore, is not whether man is, or ought to be, guided by selfish motives but whether we can allow him to be guided in his actions by those immediate consequences which he can know and care for or whether he ought to be made to do what seems appropriate to somebody else who is supposed to possess a fuller comprehension of the significance of these actions to society as a whole*' (p. 14).

A third criticism is that individual behavior may be governed by cultural factors, ruling morals, social customs or duties, habits, herd behavior, etc. However, the mentioned factors are easily incorporated in the economic framework (see e.g., Okuno-Fujiwara and Postlewaite, 1991). They simply change the perceived opportunities. That is, either agents do not perceive some objectively available options because they have never heard of such things, or because they are not used to thinking about such things, or agents perceive the consequences to be different from those which they will in fact be, for example, because they are always told so, or the consequences will indeed be different due to the behavior of other agents in their environment, etc. Moreover, these rules and norms are

themselves the result of the economic behavior of many agents (see e.g., Schotter, 1981 or Banerjee, 1992).

Fourth, although economic theory is founded on the actions of individual agents, there have been many debates concerning the ‘true’ objectives of other, compound agents, such as firms, non-profit organizations and governments. In a certain sense many of these debates have been misleading. Only preferences and perceived opportunities of individual agents eventually matter. In a very detailed model one could explicitly consider the preferences of shareholders, managers, volunteers, civil servants, politicians, etc. Often, however, it is more convenient to simplify these models by considering such organizations as a single agent. Assuming that, for example, a firm,<sup>11</sup> ‘prefers’ more profits to less may appear plausible, but it is only an abstraction from the underlying preferences of all the agents involved. Also, whether one models a government as paternalistic or uses the ‘interest function’ approach applied more recently in public choice theory depends on the issues analyzed. Whatever the appropriate simplification may be, the characteristics of economic behavior are not contested.

Fifth, frequently doubt is thrown upon the rationality of an individual agent’s actions by pointing to the undesirable outcomes they generated. However, an observation of an outcome apparently highly unfavorable to an acting agent does not necessarily imply that the action was directed against his self-interest and hence irrational. Basically, there seem to be five reasons for this. (i) One should consider the agent’s own, subjective perception *ex ante* when judging his action, and not the perception of an outside observer or the outcome *ex post*. And, of course, from a different point of view, i.e., by another agent, or at a later point in time, better opportunities might be perceivable (see also Day, 1971). (ii) But it may also be that the outcome *appears* to be highly unfavorable from the point of view of an outside observer who may easily overlook some relevant costs or benefits, while in fact it is not that unfavorable for the acting agent. For example, the agent may have performed an experiment to gather information. (iii) The outcome of the agent’s action may be stochastic and the agent may simply happen to have bad luck. (iv) The outcome may depend not only upon the agent’s own action but also upon the actions of other agents. (v) The agent may make mistakes (e.g., due to a ‘trembling hand’), which is not the same as an irrational act. Basically, a *mis*-take is a disparity between an intended action and the actual action (see e.g., Selten, 1975).

Sixth, it might be that agents do sometimes display irrational behavior, that they do act against their own perceived self-interest, that preferences themselves could be ‘irrational’, or that there might be mental states that lead to a perceived set of opportunities that is ‘irrational’. Economic theory does *not* exclude that

<sup>11</sup> According to Machlup (1967) ‘a pure construct for which there need not exist an empirical counterpart’ (p. 27).

such phenomena do occur, but it *abstracts* from them. Assumptions of a theory are by definition abstractions from reality. Abstracting from an explanation of the individual agent's preferences, and from the mental processes by which he arrives at choices, economics is just a very specific abstraction from reality. Whether these fundamental abstractions are good approximations of reality depends upon the usefulness of the explanatory discourses one can build on it. In any case, it is this what has pulled economics together from Adam Smith onwards.

In the following two sections we examine some different views on the notion of rationality in economics sometimes found in the literature nowadays, and we will see that these are incompatible with the fundamental abstractions of which *homo oeconomicus* is the personification.

### 3. Internal consistency of choices

As we have seen in the previous section, rational behavior of *homo oeconomicus* means that his actions are consistent with his preferences and perceived opportunities. Another view found in the literature holds that a prerequisite of rationality is that an individual agent's choices be consistent *with one another*. Such a consistency can be obtained by imposing certain specific conditions upon the agent's pattern of preferences. Therefore, this view applies an axiomatic approach of preferences, where the preference postulates are axioms of rationality. For example, Marschak (1950) '*defin[es] rational behavior as that which follows those rules ...*' (p. 112). As the postulates also imply the existence of an expected utility function, this view is known as the '*expected utility theory*'. It is beyond the scope of this essay to examine its history and present state<sup>12</sup>, but it seems fair to say that the Subjective Expected Utility variety based on Ramsey (1931), Von Neumann and Morgenstern (1944) and Savage (1954)) largely dominates the field of decision-making theory. When we speak of '*expected utility theory*', we have in mind the contributions, whether critical or not, that inserted themselves into the discourses following these publications.

It should be stressed that expected utility theory is a theory of rational choice, rather than rational preferences. It avoids every direct psychological assumption concerning desires, motivations, etc. Measures of preferences and probability are derived exclusively from choices. The preference axioms most frequently discussed are completeness, connectedness, invariance, sure-thing (or dominance), transitivity and independence. Various versions of standard axiomatic treatments of expected utility theory can be found in the literature (see e.g., Von Neumann and Morgenstern, 1944, Savage, 1954 or Luce and Raiffa, 1957). Here we will not discuss the details of these axioms.

<sup>12</sup> Broad surveys can be found in Schoemaker (1982) or Fishburn (1988).

Rather, we examine expected utility theory as a project of formulating a normative theory of human behavior based on some rationality axioms.<sup>13</sup> We will illustrate that this expected utility project is irreconcilable with the economic approach to human behavior. Rational agents simply choose the most preferred action in their perceived opportunity set, and it is not for economists to make any claims about their preferences. For example, one of the principal postulates concerns the transitivity of preferences. Clearly, when preferences are represented by the metaphor of utility, which is, at least, a unidimensional ordinal variable, or by logical relationships, such as ‘*implies*’<sup>14</sup>, transitivity seems obvious. However, if an agent’s available options in some sense competed with each other, just as football teams in a league do, then there would be no guarantee of transitivity of preferences. As Anand (1987) states, to his knowledge there is no one that has argued explicitly that such a ‘*competitive*’ model of preferences would be irrational or inappropriate. And certainly economics does not offer any grounds to defend such claims. But if posed the other way round, the following is also true: the normative status of the expected utility preference axioms cannot have any implications for economic theory, and in particular has no bearing whatsoever on the economic conception of rationality. Even if certain preference axioms were prerequisites of consistency, it would not be clear a priori what consistency has to do with rationality. For example, an agent whose preferences fulfil all requirements laid down in the relevant preference axioms, but always chooses the least preferred action in his opportunity set, would be very consistent, but not very rational. Economic agents are only consistent in the sense that they always choose the most preferred in their perceived opportunity set. In general, perceived opportunities will change in the course of time, and, as Binmore (1991) argues in discussing the role of small versus large worlds in Savage’s theory, ‘*[c]onsistency is only a virtue if the possibility of being surprised can somehow be eliminated*’ (p. 3).

Unfortunately, almost no expected utility theorist seems to realize that normativity has no ground to stand on, at least not in economics. This contrasts sharply with Savage (1954), who was not only very well aware of these problems, but also inserted his discourse carefully into the economic approach. ‘*Suppose someone says to me, “... I behave in flagrant disagreement with your postulates, because they violate my personal taste, and it seems to me more sensible to cater to my taste than to a theory arbitrarily concocted by you.” I don’t see how I could really controvert him, but I would be inclined to match his introspection with some of my*

<sup>13</sup> Note that, here, normativity concerns the pattern of preferences, not their contents. The postulates merely imply the existence of an expected utility function, not what will be chosen. In this sense Enlightenment ideals concerning rationality would seem to be absent.

<sup>14</sup> Savage (1954) is often considered to be an extension of logic to encompass uncertainty. For example, Schumpeter (1954) refers to it as a ‘*logic of choice*’ (p. 1058). Binmore (1991) shows this to be a misunderstanding of Savage (1954).

own. I would, in particular, tell him that, when it is explicitly brought to my attention that I have shown [intransitive] preference[s] ..., I feel uncomfortable in much the same way that I do when it is brought to my attention that some of my beliefs are logically contradictory.' (Savage, 1972, p. 21). We see that Savage recognizes that the only defence of normativism is to allude to his own preferences. Also Marschak (1950) argues that it is 'in some sense, "preferable"' (p. 112) to follow the normative rules. The uncomfortable feeling Savage refers to is most probably very similar to the feeling of a consumer who has discovered that the refrigerator bought is offered for sale just around the corner for a much lower price. 'In general, a person who has tentatively accepted a normative theory must conscientiously study situations in which the theory seems to lead him astray; he must decide for each by reflection – ... – whether to retain his initial impression of the situation or to accept the implications of the theory for it' (Savage, 1972, p. 102). Clearly, what is at stake, according to Savage is the perception of opportunities. 'If, after thorough deliberation, anyone maintains a pair of distinct preferences that are in conflict with the sure-thing principle, he must abandon, or modify, the principle; for that kind of discrepancy seems intolerable in a normative theory' (Savage, 1972, p. 102). And here Savage affirms the supremacy of the fundamentals of economics. In fact, Savage has 'liquidated' the project of a normative expected utility theory right from the start.

We do not want to deny that economists sometimes may be in the position to indicate agents how to reach their preferred goals better, i.e., when economists perform the role of engineer or management scientist. And normative economists might argue that the set of rules they recommend is inherently 'good'. But the point is that the normative character is misplaced. Given the opportunities, the only measure of 'goodness' or value we have in economics is determined by the agents' preferences. Whether individual agents follow rules or break rules depends only upon their perceived incentives to do so. This applies even to the severest rules; be they juridical, social or religious. Additional information may change the agents' perception of their opportunities. Agents will undertake action to obtain such information if the perceived cost of this outweighs the perceived benefit, and they will change their choice if, given the new information, they perceive this to be preferable. When there are enough normative theorists walking around, such information must be available at very cheap rates. In any case, normative economists are wrong in claiming that their conception of rationality is of any importance to the foundations of economic theory. Although there have been many discussions around expected utility theory, these disputes seem to have missed this fundamental issue.

Starting-point of most criticisms is the abundant empirical evidence (e.g., Allais, 1953, Ellsberg, 1961, Kahneman and Tversky, 1979, or Loomes and Sugden, 1982) that suggests that agents often deviate from these rationality axioms. Although most of the axioms have been attacked, these critics do not usually abandon the expected utility project as such. That is, they do not doubt at

all that the expected utility conception of rationality based on preference axioms is fundamental to economic theory. And it seems that they do not suspect at all that this conception is irreconcilable with the concept of rationality as in the economic approach. They merely say that the axioms as they stand need some modification, and then continue to '*build, screw, plane, file and brush*' in order to remedy the observed inconsistencies (see e.g., Fishburn, 1988; Loomes and Sugden, 1982; Machina, 1982; Kahneman and Tversky, 1979). In the remainder of this section, we will illustrate how the fundamental characteristics of the economic approach seem to be put to one side in these debates around expected utility theory.

First, it seems that often the postulated preference structures and related actions of imaginable agents in imagined situations, and the actual preferences and really perceived opportunities of their participants, who are supposed to say what they would choose in such situations, are confused. In general, there is no reason to suppose that these would coincide. This is, for example, the case in debates as to whether incentives do matter in experiments (see e.g., Thaler, 1987 or Ledyard, 1993). Of course perceived incentives are important, but probably the monetary rewards offered by the experimenter are not the only incentives perceived by the participants<sup>15</sup>, and maybe not all such monetary incentives are perceived, as the participants do not always perceive that there are in fact other advantageous opportunities waiting for them.<sup>16</sup> Well-known is also the example of young students who are asked to choose between various types of spouses (see e.g., Riker and Ordeshook, 1973). Without real consequences there seems to be little reason for the participants to give answers that suggest transitivity of their preferences with respect to spouses. '*Uncomfortable feelings*' arise, probably, only after real weddings (see also Bohm, 1990).

Second, Tversky and Kahneman (1986) note that the preference axioms are usually satisfied in transparent situations and often violated in non-transparent ones. In general, a single choice problem described in two different ways may lead people to behave in systematically different ways. This is the problem known as framing/context, and may lead to the failing of most axioms; in particular the invariance, dominance, independence and transitivity axioms. From the economist's point of view, the effect of '*framing*' is obvious. That agents make different choices in different contexts, although the underlying real opportunity set is the same, has nothing to do with preferences, but only with the fact that opportunities may be perceived differently when the choice is framed differently. And clearly a different perceived opportunity set leads in general to different actions.

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<sup>15</sup> This seems probable, for example, when are they paid only for participation, irrespective of their choices. Paying participants more with the idea that this will help to make them think better may often be senseless.

<sup>16</sup> In some cases it might be that the participants would need some years of investment in human capital to behave as the experimenter would like to. As Samuelson (1952) put it: '*If you ask a casual question, you must expect to get a casual answer*'.

Third, the transitivity axiom in particular seems to be frequently violated. Some reason that this is irrational because such individuals may be used as a 'money pump', by moving repeatedly through a certain cycle of dual choices. Suppose an agent has intransitive preferences such that  $A \succ B \succ C \succ A$ , and that he presently has got A. Given his preferences, he will be prepared to pay something in order to change from A to C. The same applies from C to B, and from B to A, after which the cycle might be repeated (see e.g., Davidson et al., 1955 or Raiffa, 1968). Here, however, a big jump is made from a static choice problem to a dynamic scenario. It does not follow either directly or necessarily from an apparently intransitive preference pattern that the agent will in fact act like a 'money pump'. For one thing, perceived opportunities are important. And in general, these will change in a dynamic context. In any case, notwithstanding abundant empirical evidence of non-transitive preference patterns, to our knowledge, no one has ever reported actual evidence of agents who did act like 'money pumps', that is of agents who did actually move *repeatedly* through such a cycle.

Fourth, the normative status of the preference axioms is frequently defended by the following argumentation. People who do experiments often observe that participants that acted against prescriptions following from certain preference axioms usually do accept these axioms when they are explained, and will follow these prescriptions when the experiment is repeated. In other words, the fact that reasonable people do this is presented as a proof that it is rational to do so. That participants often change their choice when confronted with normative talks is obvious from the economic point of view. Whenever such information is supplied to the participant, his perceived opportunity set changes in various ways. It may be that the participant did not perceive before that a more advantageous option was available. This does not mean that his previous choice was irrational, but only that it was based on less information (cf., Stigler, 1961), or poorer information processing. Furthermore, knowing that the scientist calls one of the options 'rational' and thinks 'good' people choose that option, may itself change the consequences of the choice, e.g., if the participant likes to receive appreciation and dislikes being disdained. In other words, the explanation of the organizer is not neutral and does change the perceived opportunity set. Hence, this is not a good defence of normativism.

Note that in this section we have argued that economists have nothing to say about preferences, while at the same time these preferences are considered to be the ultimate motives underlying choices. Hence, very often economists do want to make assumptions about preferences. One could attempt to model agents *as if* they maximize expected utility. Friedman and Savage (1952) state that their confidence in the hypothesis is based not upon repeated success in prediction, but upon indirect evidence. That is, they consider the postulates, with which the theory of expected utility maximization can be shown to be equivalent, rather than plausible. This confidence is however only tentative, and the hypothesis should be tested. Moreover, even if empirical evidence were favorable, the *as if* argument would

not claim any truth or closeness to reality, and no logical claims concerning rationality would follow from it. Hence, although not all the analytical apparatus used in expected utility theory is necessarily useless for economists, we should forget every pretension of its 'correctness' or 'truth', and discard every normative sense of it.

#### 4. Procedural rationality

In expected utility theory, 'the implications of reasoning for the making of decisions' (Savage, 1972, p. 6) are considered. Another approach is to focus upon this reasoning process itself. As we know, to an economist rationality means that an agent chooses the maximally preferred among his perceived opportunities. The procedures by which he arrives at such a choice are not essential for economists. Various approaches, however, not only focus upon these procedures, but even argue that certain of their characteristics are the sine qua non of rationality. According to Sen (1985), '*Rational choice is a matter of correspondence of choice to the person's reasoning and of the quality of that reasoning*' (p. 123). Rationality, in this Cartesian view, is the conscious logical *deduction* from explicit premises. A recent example of an axiomatic approach in this view is Schick (1984).

There are some economists who are confused by such 'reasonable' stories. As a result, they start mixing up the choice of the most preferred element in a set (substance) with the mathematical techniques to determine this (procedures), while these two are definitely logically distinct. According to them, rationality is the maximization of some explicit objective within the constraints of well-defined alternatives. According to Hart (1951), '*rationality consists in operating on the marginality principle*', and '*calculatingness*' (p. 4) would be a more appropriate expression to characterize what economists have in mind when they deal with rationality. Although it may be that sometimes a neat mathematical functional representation of an agent's preferences and set of perceived opportunities is possible, such that an extreme can be found by applying standard mathematical techniques, problem situations are not necessarily well-defined (see Arthur, 1992; Arthur, 1994), and this is absolutely unessential with respect to the economic conception of rationality. It might be that one of the main sources of this confusion can be found in the textbooks that are aimed at teaching students the analytic techniques used in economics, as an artisan instructs his apprentices. A very illustrative example is Klamer (1987), who asserts that the fundamental assumption of economics is the denotation of rationality as a *technique*, the optimization technique. In support of this claim, he refers to the standard textbook Varian (1984). However, in Varian (1984) the notion of rationality does not even appear once. Varian teaches his students optimization as an analytic technique, but does *not* relate it in any sense to the notion of rationality.

It is the confused, procedural, conception of rationality that forms the point of departure for the '*bounded rationality*' theory (see e.g., Simon, 1955; Simon, 1957; Simon, 1959). This theory emphasizes the fact that the individual agents' capabilities are constrained by perception, logical power and economic capacity (see e.g., Day, 1975). '*Neoclassical economists*', as Simon refers to the confused economists indicated above, do not take these constraints into account. The bounded rationality theory accepts from the confused economists it criticizes the idea that somewhere out there a *well-defined* optimization problem exists, and that perfectly solving that problem is ultimately the bench-mark of rationality. Thus, both are dealing with exactly the same *procedural* conception of rationality. The *only* point of the bounded rationality literature is that agents are *bounded* away from following the ideal optimization procedures.

Therefore, bounded rationality theory argues, agents apply '*rules of thumb*' and display *satisficing* behavior (Simon, 1957). However, this does not alter the problem a great deal. If agents apply satisficing '*rules of thumb*', the problem is simply moved back one stage. Instead of an action, agents have to choose a '*rule of thumb*', of which advocates of the procedural approach to rationality should model the decision procedure. Thus, the procedural approach to rationality in economics runs into the following well-known logical problem (see Winter, 1975). Taking account of the fact that decision-making is a costly activity necessarily leads to a more complex, meta-optimization procedure that includes the basic decision problem plus the problem how many costly resources to allocate to that original problem. As meta-optimization is costly as well, and even more so, the procedural approach leads to an infinite regress. Lipman (1991) has shown that such a regress may converge. This is an important mathematical confirmation of the following well-known fact: In reality, agents *do* make decisions, choosing what they perceive to be best for them. The problem, however, remains the following. While, from the procedural point of view, simple satisficing rules would be the outcome of a complicated infinite-but-convergent meta-meta-...meta-optimization procedure, Lipman's result does not tell us *how and what* they decide. It seems that the reason that the use of concepts such as '*rule of thumb*' and *satisficing* behavior might bear any resemblance to a way to circumvent these problems altogether, is that it has not been done very well from the procedural point of view. As Baumol and Quandt (1964) put it: '*It is, as it were, constrained maximization with only constraints and no maximization!*' (p. 24).

Clearly, we know very little about how to model the higher order procedures by which modes of decision-making are selected. There is, however, also a more basic problem involved here (see e.g., Ryle, 1949). Rather simplified, the problem is as follows. If every act were explicitly preceded by a decision procedure, then the act of decision would also be preceded by a decision to decide, etc., ad infinitum. That this well-known problem is not raised against the procedural approach more frequently, is probably due to the confusion caused by the fact that the bounded rationality literature projects decision procedures of complex bureau-

cratic organizations onto decision making by individual agents. The two should however be distinguished very clearly.

We do not want to deny that individual agents may use simple '*rules of thumb*', but argue that a procedural approach does not promise much as to the modeling of which rules they will use. Day (1993), who distinguishes seven types of decision-making (from optimization, via imitation to hunch), concludes that the decision procedure followed by an agent '*... surely has something to do with the cost and benefits of alternative modes of behavior*' (p. 66). And that brings us back to the economic approach outlined in section 2. This is not to say that all or most of the insights from the '*bounded rationality*' literature are wrong. Clearly, agents' perception of opportunities may be limited, and it may be costly to modify the set of perceived opportunities. But this idea, that perceived opportunities are of central importance, is one of the fundamental characteristics of standard economics. What is needed is a theory of '*limited perceptions*' rather than a theory of '*bounded rationality*'.

## 5. Economic theory: the modeling of rational agents

In the previous sections we have described the fundamentals of economics. In this section we will discuss some issues concerning the economic theories built on these fundamentals. Having established *that* the individual agent's actions depend upon his preferences and perceived opportunities, the central concern is how to model this.

One way to deal with preferences in economics is to ask advice about their properties from, for example, psychologists. However, one might wonder why economists should take the trouble to make specific assumptions concerning individual preferences, even if one agreed that these preferences drive the individual's actions. Until recently, the idea was that by making assumptions about individual preferences, one wanted to derive certain characteristics of aggregate behavior. By now we know that it is theoretically impossible to get the necessary characteristics of aggregate demand functions (necessary in order to prove stability of the *tâtonnement* process) by imposing more and more restrictions upon individual characteristics (see Kirman, 1992 for a survey). In other words, in the aggregate, the assumptions of individual preferences have in general no implications (see also Arrow, 1986). Therefore, approaches that rely less upon specific assumptions concerning individual preferences may be more promising. Stigler and Becker (1977) argue that preferences should not only be taken for given in economics, but can also be considered as approximately similar for everybody. Differences in actions are then completely ascribed to differences in perceived opportunities. Becker's exercise goes still further, focusing exclusively upon the perceived opportunity set (Becker, 1962). Allowing for virtually every imaginable

type of individual behavior<sup>17</sup>, he analyzes the relations between opportunity sets of individual agents and market outcomes.

This points to the principal issue concerning economic models: the modeling of the agents' perceived opportunities. The recent history of economic thought on this subject may be briefly summarized as follows. Lucas (1977), firmly rooted in the Chicago tradition, observed the threat of economics slipping into a psychology of perception.<sup>18</sup> Basically, the problem is that economists are definitely not in a position to contribute to an explanation of how a set of given physical stimuli, including both the agent's objective environment and his own brain status and activity, leads to a set of perceived opportunities. Hence, he proposed the idea of short-circuiting the problem, i.e., of abstracting from all psychological matters, by assuming that agents simply perceive the objective 'Truth'. This abstraction is essentially what the Rational Expectations Hypothesis is about.<sup>19</sup>

The next step was to observe that, before knowing the truth, agents may need some learning. As Blume and Easley (1991) pointed out, economics has now passed through that phase. We know much about when and how agents might learn the truth and when not, and about the problems that arise in certain models. However, when in the economic process perceived opportunities evolve over time, these changes will not only be due to a change in the perception of the underlying circumstances, i.e., learning, but also to a change in these circumstances themselves, as a result of the interactions between many agents. And in general, the dynamics of learning and the dynamics of economic forces as such will interact with each other. This indicates another direction to abstract from all psychological matters concerning the perception of opportunities.

Assume that the perception of opportunities is an endogenous process, i.e., that the set of perceived opportunities depends strictly upon the preceding sequence of actions. We know that rational economic agents choose the best option in their perceived opportunity set. Hence, in a formal model, actions will be a function of perceived opportunities, while these perceived opportunities are a function of earlier actions. As a result, one gets a sequence analysis of actions and outcomes in which perceptions or expectations do not appear explicitly, but only '*between the lines*' (Hart, 1951, p. viii), and one can consider economic dynamics in the sense of '*the study of economic phenomena in relation to preceding and succeeding events*' (Baumol, 1970, p. 4).

Hence, each rational individual agent's actions can be modeled as a function of previous actions and outcomes. Clearly, to tie down the set of functions a priori in an ad hoc way would not be very interesting. Fortunately, the current availability

<sup>17</sup> Becker (1962) calls it '*irrational*' behavior, which he defines as every kind of behavior *not* equal to choosing the most preferred option in the perceived opportunity set.

<sup>18</sup> See the quotation in section 2.

<sup>19</sup> In this sense, Guesnerie's attempt to provide a *psychological* foundation for Rational Expectations is paradoxical (Guesnerie, 1992).

of Artificial Intelligence techniques, such as Artificial Neural Networks and Genetic Algorithms/Classifier Systems, makes it possible to keep the relations between actions and previous actions completely flexible (see Vriend, 1994). Then, one is in a position to analyze how far '*the market*' provides sufficient structure to tie down the set of perceived opportunities, i.e., to constrain the behavior of the individual agents (cf., Becker, 1962).<sup>20</sup> Thus, the increasing use in economics of studies of decentralized economies, in which one looks for the emergence of regularities in actions and outcomes during the simulated process of creating and trading away of opportunities by individual agents<sup>21</sup>, should not be viewed as a necessary alternative for economic models based upon allegedly overly strong rationality assumptions, but, instead, as a logical *continuation* of the economic approach. After all, as Lucas puts it, doing economics means '*programming robot imitations of people*' (in Klamer, 1984, p. 49).

To conclude, some economists might find the basic message of this essay, that rationality is necessarily constrained to be a contentless notion in economics, *bad news*. However, the *good news* of this essay is that, given the currently available AI techniques and taking Lucas' statement literally, the economic approach to human behavior allows us to do *economic* analyses even when problems may be ill-defined, and in cases of uncertainty.

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<sup>20</sup> To say that perceptions need not enter explicitly into economic models is *not* to say that they are unimportant. Perceived opportunities *are* of fundamental importance for economic agents. Only the consideration of exogenous *changes* in perceptions is banned, as those would sweep away every hope to find constraints imposed by the market process upon the individual agents' possible perceptions.

<sup>21</sup> See e.g., Marimon et al. (1990), Andreoni and Miller (1991), Rust et al. (1992), Arthur et al. (1994), or Vriend (1995).

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