Economics and psychology.Perfect rationality versus bounded rationality

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Abstract°

Classical mathematical algorithms often fail to identify in time when the international financial crises occur although, as the classical theory of choice would suggest, the economic agents are rational and the markets are or should be efficient and behave also rationally.
This contribution does not pretend to give a complete answer to these questions, but it will highlight some well-known limits of the classical theory of rational choice and compare this theory of choice with the approach that seeks to combine economics and psychology and that has established itself as cognitive or behavioral economics. In particular, the present paper will focus on the juxtaposition of the concepts of perfect rationality and bounded rationality. It concludes with some references to the literature of behavioral finance which has given important contributions in explaining the behavior and the anomalies of financial markets.

Introduction

The economic and financial crisis has created a climate of great uncertainty. People ask why speculation is constantly present in the markets and why individuals (at least some of them) are incapable of curbing speculative instincts to preserve the common good, the stability of the all system rather than the (hefty) gains of a few. Thus we wonder why the classical mathematical algorithms often fail to identify in time when the international financial crises occur if, as the classical theory of choice would suggest, the economic agents are rational and the markets are efficient and behave also rationally.
This contribution does not pretend to give a complete answer to these questions, but it will highlight some well-known limits of the classical theory of rational choice and compare this theory of choice with the approach that seeks to combine economics and psychology and that has established itself as cognitive economics. In particular, the paper will focus on the juxtaposition of the concepts of perfect rationality and bounded rationality, the latter has in Herbert Simon its most influential theorist. It concludes with some references to the literature of behavioral finance which has given important contributions in explaining the behavior and the anomalies of financial markets.

1. Economics and the 'perfect' rationality.

Economics in its classical conception is seen as a normative theory (how we should act). In its neo-positivist approach of systemic-formal nature, economics takes the form of nomologic - deductive propositions, which are obtained by reasoning, starting from unproven axioms. With these axioms we deduce the propositions of the theory, which requires the use of logic and mathematics. Thus economics presents itself as a rational science in the sense that its propositions are obtained by means of logic, in a way which is similar to rational mechanics. In economics, moreover, rationality is interpreted in terms of consistency not of substance. We have therefore a syntactic and non-semantic notion of rationality. The agents are rational if they have a coherent criterion of choice. The consistency of the choices implies that the agents are represented by a system of preference. Economics describes the choice as a rational process driven by a single cognitive process that includes the principles of the *Theory of rational choice* and it orders the decisions on the basis of their subjective expected utility.
In this view the "*homo oeconomicus"* appears perfectly rational and has a complete knowledge, while his economic choices, guided by rationality, are self contained in the economic sphere without affecting other aspects of the individual such as the emotions or being influenced by the environment.

°Key words: Bounded rationality, procedural rationality, Rational choice, cognitive economics.
JEL Classification: C00, B52, D81, D83.

1.1 **The Theory of Rational Choice.**

Let us analyze the theory of rational choice (TRC). The first basic parameter which is taken into consideration by the TRC is the 'preference'. The theory sets several basic axioms on the preference of a rational agent. It follows that an agent who wishes to call himself fully rational must align his preferences to each of these conditions.
Given the expressions of preference relation xPy ("x is preferred to y") and the relationship of indifference xIy ("x is indifferent to y"), these conditions are the following

1. If xPy, then no yPx.
2. If xPy, then no xIy.
3. If xIy, then no xPy and also no yPx.
4. xPy or yPx or xIy, for any two relevant results x and y.
5. If xPy and yPz, then xPz.
6. If xPy and xIz, then zPy.
7. If xPy and yIz, then xPz.
8. If xIy and yIz, then xIz.

Conditions 1 – 3 are usually considered as a single order condition, while the conditions 5 – 8 are called conditions of transitivity. The different ways of numbering the elements in an order of preference are called 'utility functions' or 'utility scales' for the subject. The utility functions are therefore the instrument to characterize the preferences of an individual.
By means of the utility functions it is possible to decline formally the principle of maximization.
If an individual's preferences satisfy appropriate consistency conditions, then it is possible to associate a numerical value to each outcome through a utility function $u : E \rightarrow R$.
In the field of analysis of choice under uncertainty, the most important contribution is the expected utility theory, proposed by von Neumann and Morgenstern (1944). The theoretical framework of von Nuemann-Morgenstern is generally accepted as a normative model of rational choice. In this model rational agents want to obey its axioms.
According to von Neumann and Moregenstern, individuals generally move in the reality following predetermined patterns of behavior, at the base of which there is the assumption that they always prefer to have a greater wealth than less. The theory studies the preferences underlying consumer behavior under risk, i.e. when the subject is asked to make a decision without knowing with certainty which *ex ante* state of the world will happen, but he knows the probability distribution, that is, it is known to him a list of possible events, each of which he associates a probability of occurrence. This theory assumes that each individual has stable and consistent preferences, and that he makes decisions based on the principle of maximization of subjective expected utility. So given a set of options and beliefs expressed in probabilistic terms, it is assumed that the individual maximizes the expected value of a utility function u (x). The individual uses probability estimates and utility values as elements of calculation to maximize his expected utility function. Thus he evaluates the relevant probabilities and utilities on the basis of his personal opinion but also using all relevant information available.
The expected utility theory is nothing more than a criterion that facilitates choice under risk, we get the utility function that can take three forms:

i) is concave when describing the preferences of a risk averse individual;
ii) is convex type when describing the preferences of an individual willing to risk;
iii) is linear when describing the preferences of a risk-neutral individual.

Thus an individual averse, neutral or risk lover has indifference curves convex, linear or concave.
There are five axioms which the preferences must satisfy such as to represent them through the expected utility.

1. The first axiom requires that preferences are complete and consistent. Given two or more distributions an individual is always able to indicate that he prefers; he always knows how to

choose and place the distributions in some order on the scale of preferences. *The consistency requirement implies that preferences are transitive*. If you prefer the distribution A to B and B is preferred to C, then A is preferred to the distribution of C; if this does not happen it would create a circularity and the individual would not be able to choose. The axiom reminds us that intrasitive preferences lead to irrational behavior.

2. The second axiom is that of monotonicity which requires that an individual, given two distributions that have the same consequences, tends to prefer the opportunity that offers the best result with the highest probability.
3. The third axiom of continuity implies that a subject, that is before an alternative by which he can achieve with certainty a given result or to have a probability distribution that gives with probability α the better event and with probability 1– α the worst event, is always able to give a probability α that makes him indifferent between the two alternatives.
4. The fourth axiom of independence is crucial for the formulation of the expected utility, so as to be valid it is necessary that the utilities of each consequence are weighted by their probabilities and summed. The sum operation is possible only if the utilities are independent. Suppose an individual is indifferent between two events which are certain, then he will also be indifferent to a combinations of all these events with any distribution for any probability.
5. The last axiom is that of reduction. Suppose we roll a die: if there is 1 we win otherwise we lose; thus we have a chance of winning equal to one sixth. The prize does not consist in a certain sum of money but in the partecipation in a lottery whose probability of winning is equal to one third. The axiom of reduction asserts that what matters for the individual is the overall probability of winning equal to 1/6 x 1/3 = 1/18 since the two games are independent, not the pleasure to partecipate to individual games; the premise also assumes that the individual is always able to calculate such a probability.

The most important result of this theory is the expected utility theorem.

1.2 Expected Utility Theorem.

Given the five axioms it is possible to build one and only one intervallic function u which has the following properties:

I) $u(x) > u(y)$ if and only if xPy.
II) $u(x) = u(y)$ if and only if xIy.
III) $u[L(a,x,y)] = au(x) + (1 - a)u(y)$.

Any $u*$ which satisfies I)-III) is a positive linear (affine) transformation of u.

The expected utility theory has been generally accepted as a normative model of rational choice, defining what decisions are rational. If an individual does not maximize his expected utility he is designed to violate in his choices some precise axiomatic principles, which are rationally binding. This theory has also been applied as a descriptive model of economic behavior (Friedman, Savage, 1948; Arrow, 1971) so as to constitute an important reference model for economic theory.
Finally, what emerges form the analysis of choice under uncertainty is the complexity of the system of choice. In the fact one must take into account three conditions of rationality, namely the existence of a regular system of preferences on the consequences, the rationality of expectations about the consequences of actions, the rationality of the function that determines the system of preference on the actions, on the basis of expectations about the consequences of actions and the consequences to the system of preference (Montesano, 2005, p.7).

2. Psychology into Economics. The cognive dimension.

Within the scientific community there has been a growing need to consider adequately the complexity of economic phenomena and processes that guide the choices of the individuals.
During the fifties there has been important explorations along the boundaries between economics and psychology. This line of reseach determined the development of behavioral economics which exactly relates psychological factors to economic behavior. Experimental results had emerged that questioned the validity of the classical model of rational choice (Simon, 1959). On the one hand, Simon's approach, developed on bounded rationality and problem solving, criticized – on the basis of analysis conducted on the field – the lack of realism of the neoclassical economic theory based on the assumption of full rationality. On the other hand, the pioneering experimental studies of Allais in 1952 that set violations of utility theory, proved the systematic discrepancy between the predictions of traditional decision theory and actual behavior.

2.1. The Allais' Paradox

Let's start from the "Allais' Paradox".
In 1952, Maurice Allais presented in Paris his famous paradox" to an audience composed of the best economist of his generation; among others, Kenneth Arrow, Paul Samuelson, Milton Friedman, Jacob Marschak, Oskar Morgenstern and Leonard Savage.
The "paradox" consists in presenting a subject in two situations. In the first situation **(A)** the person is proposed to choose between getting for sure \$ 1,000,000 (a) and receive a lottery (b) which has 0.1 probability to win \$ 5,000,000, 0.89 probability of winning \$ 1,000,000 and 0.01 probability of not winning anything. In the second situation **(B)** the person is proposed to choose between a lottery (c) which has 0.1 probability to win \$ 5,000,000 and 0.9 probability of not winning anything, and another lottery (d) which has 0.11 chance of winning \$ 1,000,000 and 0.89 probability of not winning anything. We would expect that a rational individual chooses (a) in the first situation and chooses (c) in the second situation. But this outcome, apparently evident, contradicts the utility theorem. In fact, calculating the utilities for each choice we obtain:

$u\,(a) = u\,(1M)$
$u\,(b) = 0.1\,u\,(5M) + 0.89\,u\,(1M) + 0.01\,u\,(0)$
$u\,(c) = 0.1\,u\,(5M) + 0.9\,u\,(0)$
$u\,(d) = 0.11\,u\,(1M) + 0.89\,u\,(0)$

From which:

$u\,(a) - u\,(b) = 0.11\,u\,(1M) - [\,0.1\,u\,(5M) + 0.01\,u\,(0)]$
$u\,(d) - u\,(c) = 0.11\,u\,(1M) - [0.1\,u\,(5M) + 0.01\,u\,(0)]$

The utility theorem tells us that if the individual prefers (a) with respect to (b): (u(a) > u(b)) in the first situation **(A),** then the individual must prefer (d) to (c) : (u (d)> u (c)) in the second situation **(B)** and vice versa, hence the "paradox".
Therefore the results of laboratory experiments conducted by Allais[1] have shown tha individuals chose incosisently and that they preferred solutions which did not maximize the expected utility. In this way Allais have demonstrated that the axiomatic definition of rationality did not allow to describe and even predict economic decisions.
Another "paradox" has been identified by Ellsberg (1961), who, by means of experiments, demonstrated another type of inconsistency in preferences, showing that individuals prefer to bet on a lottery with a chance of obtaining a win already known that on a lottery with ambigous results.

[1] Allais (1953).

This aversion to uncertainty (ambiguity) of the individual is completely ignored in the expected utility model from a descriptive point of view, while is not considered acceptable from a normative point of view.

2.2. Bounded Rationality

In economics the concept of bounded rationality is associated to Herbert Simon (1955, 1956, 1957, 1972, 1979, 1991), who proposed the idea of bounded rationality as an alternative basis for the mathematical modeling of decision making. Simon has coined the term ‘bounded rationality’ in *Models of Man* (1957). In his view, rationality of individuals is limited by the information they have, the cognitive limitations of their minds, and the finite amount of time they have to make decisions. Bounded rationality expresses the idea of the practical impossibility (not of the logical impossibility) of exercise of perfect (or ‘global’) rationality (Simon, 1955). “Theories that incorporate constraints on the information-porcessing capacities of the actor may be called *theories of bounded rationality*” (Simon, 1972, p.162). Simon argues that most people are only partly rational while are emotional/irrational in the remaining part of their actions. He maintains that although the classical theory with its assumptions of rationality is a powerful and useful tool, it fails to include some of the central problems of conflict and dynamics which economics has become more and more concerned with (Simon, 1959, p.255). Simon identifies a variety of ways to assume limits of rationality such as risk and uncertainty, incomplete information about alternatives, complexity (1972, pp.163-164). Furthermore, he asserts that an individual who wants to behave rationally must consider not only the objective environment, but also the subjective environment (cognitive limitations), thus you need to know something about the perceptual and cognitive process of this rational individual. Simon, therefore, considers the psychological theory very important to enrich the analysis for a description of the process of choice in economics. This is why he adopts the notion of procedural rationality, a concept developed within psychology (Simon, 1976), which depends on the process that generated it, so rationality is synonymous of reasoning. According to Simon a search for procedural rationality is the search for computational efficiency, and a theory of procedural rationality is a theory of efficient computational procedures to find good solutions (Simon, 1976, p.133). Procedural rationality is a form of psychological rationality which constitutes the basic concept of Simon’s behavioral theory (Novarese, Castellani, Di Giovinazzo, 2009; Barros, 2010, Schilirò, Graziano, 2011), in contrast to economic rationality, defined by Simon as ‘substantive rationality’.

Another way to look at bounded rationality is that, because individuals lack the ability and resources to arrive at the optimal solution, they instead apply their rationality only after having greatly simplified the choices available. Actually, individuals face uncertainty about the future and costs in acquiring information in the present. These two factors limit the extent to which agents can make a fully rational decision. Thus, Simon claims, agents have only bounded rationality and are forced to make decisions not by 'maximization', but rather by satisficing[2], i.e. setting an aspiration level which, if achieved, they will be happy enough with, and if they don't, try to change either their aspiration level or their decision. Satisficing is the hypothesis that allows to the conception of diverse decision procedures and which permits rationality to operate in an open, not predetermined, space (Barros, 2010). Real-world decisions are made using fast heuristics, 'rules of thumb', that satisfice rather than maximize utility over the long run. Thus agents employ the use of heuristics to make decisions rather than a strict rigid rule of optimization. The agents do this because of the complexity of the situation, and their inability to process and compute the expected utility of every alternative action. In fact there are limits of attentional capacity, mnemonic and computational binding the computational load, hence the usefulness of automatic routines.

[2] The term ‘satisficing’ appears in Simon, 1956. Later Simon (1957, p.205) says “The key to the simplification of the choice process…is the replacement of the goal of *maximizing* with the goal of *satisficing*, of finding a course of action that is ‘good enough’ “.

Rationality is bounded by these internal constraints in the uncertain real world. Simon then relates the concept of bounded rationality to the complementary construct of procedural rationality, which is based on cognitive processes involving detailed empirical exploration and procedures (search processes) that are translated in algorithms, in contrast to the notion of perfect rationality, that is based on substantive rationality, which derives choices from deductive reasoning and from a tight system of axioms, an idea of rationality that has grown up strictly within economics (Simon, 1976, 1997). For Simon "as economics becomes more and more involved in the study of uncertainty, more and more concerned with the complex actuality of business-decision making, the shift in program will become inevitable. Wider and wider areas of economics will replace the over-simplified assumptions of the situationally constrained omniscient decision-maker with a realistic (and psychological) characterization of the limits on Man's rationality, and the consequences of those limits for his economic behavior" (Simon, 1976, pp.147-148).
Simon, however, does not reject the neoclassical theory *tout court*, he describes a number of dimensions along which neoclassical models of perfect rationality can be made somewhat more realistic, while sticking within the vein of fairly rigorous formalization. These include: limiting what sorts of utility functions there might be, recognizing the costs of gathering and processing information, the possibility of having a "multi-valued" utility function.
Simon's work has been followed in the research on judgment and decision making, both in economics and psychology. Two major approaches produced important insights into perception mechanisms shaping the individual's internal representation of the problem: the ''heuristics and biases" program (Tversky, Kahneman, 1974), which has been fundamental to the contemporary development of behavioral economics. Tversky and Kahneman, in fact, offer a theoretical explanation about the observed deviations from perfect rationality, noting that people rely on " heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations" (1974, p.1124). They therefore do not abandon the assumption that individuals are intelligent and intentional in making decisions, but they assume systematic and specific biases that move away the judgement from the perfect rationality of individuals. Moreover, accordin to Kahneman and Thaler (2006) to accept a model where individuals maximize their utility function, which by hypothesis is perceived to be consistent, accurate and also stable over time, is not possible anymore, because individuals often make systematic errors in predicting their future experience and results, thus failing to maximize their utility. This occurs because individuals in acting face real difficulty in assessing their preferences and, therefore, prefer the pursuit of instant gratification, which, however, are often inconsistent with their long-term preferences (Rabin, 1998). The "failures" of perfect rationality depend also on the specific ways in which people select and process the information mentally. The attitude to risk of the individual varies depending on frame within which lies the choice (Kahneman and Tversky, 1979). In fact, Kahneman and Tversky with their 'Prospect theory' have shown experimentally the presence of inconsistent judgments and choices by an individual facing the same problem presented in different frames ('invariance of failures'). It follows that the frame, or the context of choice, *ceteris paribus*, helps to determine a different behavior. Among the violations of the expected utility paradigm, that have a psychological motivation and which are important in the financial choices, in particular there are the risk aversion and, above all, the loss aversion (Kahneman and Tversky, 1984)[3]. Kahneman and Tversky have shown, for example, that many of the risks of little importance is given disproportionate weight, but also that the losses and future earnings are not treated symmetrically.
The other approach, derived from Simon's work, is the ''fast and frugal heuristics" program (Gigenzer, Goldstein, 1996; Todd, Gigerenzer, 2003). These fast heuristics are conscious

[3] For most individuals, in fact, the motivation to avoid a loss is greater than the motivation to make a profit. This general psychological principle, which is connected to a kind of survival instinct, causes that the same decision gives rise to opposite choices depending on whether the results are presented to the subject as losses rather than as loss of earnings. This type of evidence has led Kahneman and Tversky (1979, 1984) to develop the theory of prospects within the cognitive-behavioral approach.

processes, accessible to introspection in humans. Following Simon's notion of satisficing, Gigenzer and Goldstein have proposed a family of algorithms based on a simple psychological mechanism: one-reason decision making. These fast and frugal algorithms violate fundamental tenets of classical rationality: they neither look up nor integrate all information (Gigenzer, Goldstein, 1996). The heuristics are determined by a trade-off between the limits of the human mind and the computing performance required by complex problems. The psychology of choice is to codify these heuristics in humans, to help apply them in situations where they work well. Finally, Ariel Rubinstein (1998) proposed to model bounded rationality by explicitly specifying decision-making procedures. Rubinstein has contributed to put the study of decision procedures on the research agenda.

3. Behavioral Finance

3.1. Asset allocation

The theory of expected utility applies to financial investment decisions, it is the Asset allocation theory, where the investment decision possibilities is represented by a function with the different choice of risky investments taking into account their expected value.
If A and B are two risky alternatives, the expected utility theory enables to state that

$A < B$ if and only if $E[\boldsymbol{u}(A)] < E[\boldsymbol{u}(B)]$

where the symbol < indicates the preference of B with respect to A and the function $\boldsymbol{u}$ (.) represents the utility function.
The risky choice of B is preferred to the risky choice of A if the expected value of the utility function B is higher than the expected value of the utility function A.
The utility function is increasing and concave with respect to risk aversion.
The assumptions are:

1. Independence axiom

$$\mathbf{A < B \text{ implies } \alpha A + (1-\alpha)C < \alpha B + (1-\alpha)C, \text{ for every } C}$$

2. Equivalent Probability

Assume a lottery that gives value W_H and W_L. The probability of W_L is p.
An investor is risk averse if:

$$\mathbf{pu(WH) + (1 - p)\, u(WL) < u(pWH + (1 - p)WL)}$$

Consider a change of probability from p to q

$$\mathbf{q\boldsymbol{u}(W_H) + (1 - q)\, \boldsymbol{u}(W_L) = \boldsymbol{u}(qW_H + (1 - q)W_L)}$$

if changing the probability fron p to q, then the final relation remains unchanged, it means that, regardless of the various probabilities, the probability that will result a lottery rather than another is equivalent.

3.Certain Equivalent

Let us assume a lottery. This can give as a result WH and WL. The probability of getting WH is equal to p.

If

p*u*(WH) + (1-p) *u*(WL) < *u* (pWH + (1-p)WL)

thus investor is risk averse.

The certain equivalent is WCE if

p*u*(WH) + (1-p)*u*(WL) = *u* (WCE)

i.e. if the mathematical relation which identifies the risk averse investor is equal to WCE, then WCE is the certain equivalent, whose utility is the expected utility of the lottery.

3.2. Expected utility and risk aversion

Let's examine the relation between expected utility and risk aversion.
Consider a lottery W, with mean E(W); this is a safe return, but not winning the lottery. It is a certain event.
An individual is called risk-neutral if it indifferent to perceive definetely a sum equal to E(W) or the lottery W. Then

E[u(W)] = u (E (W)).

An individual is instead risk averse if he prefers the sum E (W) to the lottery W. Then

E[u(W)] < u (E (W)).

i.e. an individual is risk averse if he prefers a smaller but certain sum.
To measure the degree of risk aversion we try to determine a value π such that

E[u(W)] = u (E (W) - π).

With the Taylor's expansion we can verify that

$\pi = \frac{1}{2} (- u''/ u')$ Var (W)

Where u' and u" are the first and the second derivate of the utility function.
The literature on financial behavior has set forth that the various utility functions are different for the different behavior of risk aversion, relative or absolute, to changes in wealth. There are several utility functions that differ according to the change in risk aversion with respect to wealth. That is, it has been shown that individuals, on the basis of their wealth, have a different risk aversion.
Among the utility functions we can cite the quadratic utility function, which has the unrealistic feature of risk aversion that increases with wealth. Another is the exponential function or constant absolute risk aversion (CARA). A third is the power utility or constant relative risk aversion (CRRA). A fourth is the logarithmic utility function, an extreme case of the CRRA. Finally the hyperbolic absolute risk-aversion (HARA). This function represents the most general case, to measure the linear risk tolerance based on wealth. It is the function commonly used to measure risk aversion.

3.3 Anomalies and biases in the behavioral finance

From the seventies onwards there has been the growth of a new branch of finance: the behavioral finance, which in itself combines aspects of cognitive psychology and financial theories in the strict sense. In practice this new approach seeks to explain the so-called financial market “anomalies” by analyzing the behavior of economic agents. The adoption of heuristics by individuals is necessary to solve the problems of everyday life, but in the financial sector it can lead to biases which have proved very expensive.
In their Prosepct theory Kahneman and Tversky (1979, 1984) criticize the classical approach of the expected utility and offer a theory based on the existence of a ‘Reference Point: They argue that any individual has a deformation of the probability, which is different between gains and losses and, morever, the individual has aversion to losses. A loss, in fact, is more weighted by a psychological point of view than a gain.
Their utility function is:

$$\mathbf{u(r) + w^{+}(p)\,(u(Wh) - u\,(r)) - \lambda w^{-}(1 - p)(u(r) - u(WH))}$$

r = reference point
$w^{+}(p)$ = deformation of the positive probability in its functional form.
λ = risk aversion.
According to this theory the utility function of a given asset compared to a reference point is given by the utility function of the reference point itself, plus the deformation of the positive probability (which represents the probability of the pleasant event) of the utility function (Wh) less the deformation of the negative probability (the probability that the hoped event does not happen) of the utility of the reference point less the sought event.
Another issue which is relevant for the decisions of financial investment is the rejection, based on empitical tests (Thaler, 1980) of the postulate of the theory of rational choice that preferences are invariant with respect to the capital position of the individual at the time. According to Thaler (1980), your choices are influenced by the “endowment effect” if you are brought to ask for goods in your possession more than you would be willing to pay for it, if you do not already own that good.
Kahneman, Knetsch and Thaler (1990) also carried out a significant experiment based on the “endowment effect”, in which they demonstrate that the individuals feel a great sorrow when they loose the objects they possess, more than the pleasure would cause them to acquire those same objects, if they do not already possess them. So the “endowment effect” is an anomaly that causes a *statu quo* bias (a preference for the current state that biases the individual against both buying *and* selling his object). The “endowment effect” is also connected to a particularly pervasive phenomenon: the “loss aversion”, for which the disutility of a loss is greater than the utility of a win of the same size.
Thus, the literature of behavioral finance includes the lack of symmetry between decisions to acquire and maintain resources and the strong aversion to the loss of some (emotionally) valuable resources that could be completely lost. In the field of behavioral finance, the loss aversion appears to manifest itself in the investor behavior as an unwillingness to sell assets or other securities, if doing so forces the investor to achieve a nominal loss (Genesove and Mayer, 2001). This loss aversion help to explain in particular why housing market prices do not adjust downwards during periods of low demand.
The models of behavioral finance, used in the valuation of assets, usually criticize the idea of 'informational efficiency of markets”, underpinned by Fama (1970), that a market is efficient in the sense of information if at all times the stock prices fully and correctly reflect all the available information. The theory of market efficiency has been challenged, for instance, by the discovery of some anomalies that would produce excess returns. De Bondt and Thaler (1985) have shown that bonds, characterized by particularly high yields (so-called winners), record in the aftermath the

worst yield and vice versa. This depends on investors' overreaction to an event. Over the time the investors realize the error and correct their assessments causing a reversal of returns.

Finally, Thaler and Shefrin (1981), who gave major contributions to behavioral finance, present their behavioral life-cicle theory arguing that economists who wish to analyze the consumption-saving decision must address the bounded rationality and impatience of consumers. The behavioral-life cicle theory models consumers as responding to psychological limitations by adopting rules-of-thumb, such as mental accounts, that are used to constrain the decision making of the myopic agent.

An alternative approach to behavioral economics that can be applied to financial markes is that offered by neuroeconomics, a discipline at the turn of neuroscience and economics, which aims at studying the processes underlying the decision-making choices and that reveals what instincts are activated when you have to do with the risk, the gains and losses. Neuroeconomics tries to offer a solution through an additional set of data obtained via a series of measurements of brain activity at the time of decisions. Neuroeconomic theory proposes to build brain-based models capable of predicting observed behavior (Brocas, Carrillo, 2010). The underlying idea of neuroeconomics is that the brain is a multi-system entity with restricted information and conflicting objectives characterized by bounds of rationality, so the decision-maker must be modelled as an organization. This realtively new approach can be considered another development of Simon' s intuitions.

Conclusions

The financial crisis has raised many questions and created new problems for economic theory. It is not all certain that the mathematical algorithms devised by the classical theory can predict in time when the international financial crises occur, but, as this paper tried to argue, we can enrich our knowledge of the complex reality of financial markets through the fertile contribution of behavioral economics.

Thus the present contribution discussed the criticism to the classical theory of rational choice and to the expected utility coming from cognitive or behavioral economics. Moreover, the notion of perfect rationality has been confronted with the concept of bounded rationality as formulated by Herbert Simon. It has been underlined the relation between bounded rationality and procedural rationality which is the form of psychological rationality that constitutes the basic concept of Simon's behavioral theory. Failures of classical theory of rational choice, anomalies and biases in the behavior of the economic agents in financial markets has been pointed out, although the critical part of the behavioral theory seems more convincing than the positive and proactive part of the same theory, leaving a significant degree of indeterminacy in defining solutions.

A possible answer to the questions posed by the financial crises could come from neuroeconomics. The latest crisis has been largely the result of a collapse of financial markets and confidence; according to neuroeconomic theory, it would be an effect of automatic processes and unconscious decisions much more than deliberate and conscious decisions. Thus, neuroeconomists argue that to prevent market crises may be feasible in the future, thanks to new financial models that take into account the neuro-cognitive constraints, i.e. the mechanisms put in place by the brain in response to certain environmental stimuli, and the influence of emotions on the choices of investment.

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