



Keynes's methodology and the analysis of economic agent behavior in a complex world

Richard Arena, Eric Nasica

IN **REVUE D'ÉCONOMIE POLITIQUE** 2021/3 Vol. 131 , PAGES 371 TO 402

PUBLISHER **DALLOZ**

ISSN 0373-2630

DOI 10.3917/redp.313.0053

Uploaded: 07/09/2021

Article available online at

<https://shs.cairn.info/journal-revue-d-economie-politique-2021-3-page-371?lang=en>



Discover the contents of this issue, follow the journal by email, subscribe...
Scan this QR code to access the page for this issue on Cairn.info.



Electronic distribution Cairn.info for Dalloz.

You are authorized to reproduce this article within the limits of the terms of use of Cairn.info or, where applicable, the terms and conditions of the license subscribed to by your institution. Details and conditions can be found at cairn.info/copyright.

Unless otherwise provided by law, the digital use of these resources for educational purposes is subject to authorization by the Publisher or, where applicable, by the collective management organization authorized for this purpose. This is particularly the case in France with the CFC, which is the approved organization in this area.

Keynes's methodology and the analysis of economic agent behavior in a complex world

Richard Arena*
Eric Nasic**

This article aims to analyze the impact of taking into account a truly uncertain and complex economic environment on the methodology used by Keynes. Our work leads to two main results. The first conclusion is that, even when an ordinal or cardinal measure of probability is impossible, Keynes provides a coherent set of tools for the analysis of economic decisions. In particular, even if a numerical probability cannot be determined, the choices of economic agents will be rationally governed by reasoning based on their limited but real knowledge of the observed reality and on non-numerical probabilities. The second result obtained is that the complex decision-making environment surrounding economic decisions influences the characterization of the individual actor himself and economic and social interactions; this form of economic analysis implies referring to a methodological conception which is open to and even requires the use of philosophy and other social sciences as cognitive psychology, social psychology and even anthropology.

Keynes's methodology – Uncertainty – Complexity – Rationality – Logical probability – Treatise on Probability – Economic agent behavior – Philosophy – Psychology

La méthodologie de Keynes et l'analyse du comportement de l'agent économique dans un monde complexe

Cet article vise à analyser l'impact de la prise en compte d'un environnement économique réellement incertain et complexe sur la méthodologie utilisée par Keynes. Notre travail aboutit à deux résultats principaux. La première conclusion est que, même lorsqu'une mesure ordinaire ou cardinale de la probabilité est impossible, Keynes fournit un ensemble cohérent d'outils pour l'analyse des décisions économiques. En particulier, même si une probabilité numérique ne peut être déterminée, les choix des agents économiques seront rationnellement régis par un raisonnement basé sur leur connaissance limitée, mais réelle, de la réalité observée et sur des probabilités non numériques. Le second résultat obtenu est que l'environnement décisionnel complexe entourant les décisions économiques influence la caractérisation de l'agent économique lui-même et implique de se référer à une conception méthodologique de cet agent et de l'économie qui soit ouverte à une forme d'analyse économique qui recourt

* Université Côte d'Azur, CNRS, GREDEG. Email: Richard.ARENA@univ-cotedazur.fr

** Université Côte d'Azur, CNRS, GREDEG. Email: Eric.NASICA@univ-cotedazur.fr

à l'utilisation systématique de la philosophie et d'autres sciences sociales comme la psychologie cognitive, la philosophie sociale ou encore l'anthropologie.

Méthodologie de Keynes – Incertitude – Complexité – Rationalité – Probabilité logique – Traité des Probabilités – Comportement de l'agent économique – Philosophie – Psychologie

JEL codes : B21, B22, B31, B41, D81, D84, D91, E12, E71

1. Introduction

The intellectual revolution triggered by Keynes's *General Theory of Employment, Interest and Money* ([1973b] [1936]; hereafter *GT*) is often described as a shift in emphasis from microeconomics to macroeconomics, and as a shift from study of optimal behavior of the individual consumer or the individual firm to study of broad statistical aggregates, such as income and employment, or consumption and investment. For a long time macroeconomists thought it unnecessary to provide a special explanation of individual behavior, but eventually after the nineteen-eighties traditional microeconomics was introduced into the Keynesian model to provide "micro foundations" and to explain individual decision making. However, Keynes never used the term "macroeconomics", and it soon became obvious that there was an inherent tension between the traditional approach to optimal individual behavior and the Keynesian explanation of the movements of income and employment.

Keynes in *GT* drew a distinction between analysis of an economy "*subject to change, but where all things are foreseen from the beginning*" and "*the problems of the real world in which our previous expectations are liable to disappointment and expectations concerning the future affect what we do to-day*" (*GT*, p. 293-4; emphasis added). In the preface to the book he had already emphasized that his intention was to analyze a "monetary economy" which he defined as "*one in which changing views about the future are capable of influencing the quantity of employment and not merely its direction*". He went on to add that this would require a "*method of analyzing the economic behavior of the present under the influence of changing ideas about the future*" which fundamentally differed from the method employed by traditional theory (*GT*, p. vii).

Far from ignoring the problems of explaining the behavior of economic agents, Keynes called for a more general explanation of behavior in more *realistic* conditions. The traditional view of Keynes's theory as "macroeconomics" rather than the theory of a "monetary economy", has thus quite naturally overlooked what it did not expect to be there, but which Keynes considered to be the very heart of his approach, namely, a theory of individual behavior in an economy subject to change. The aim of this paper is to spell out Keynes's ideas on this subject in more detail.

Our work aims to show that the complex decision-making environment induced by Keynes' vision of the "real world" is central to his approach

because it strongly conditions his analysis of individual behaviors. To do this, our paper is organized as follows. First, we will show how this environment is used by Keynes to build an original and coherent methodology aiming at analyzing rationality under uncertainty in a way radically different from “classical” approaches and above all more adapted to the characteristics of an economy subject to change (Section 2). Second, we study how it influences the way we can characterize the individual actor himself referring to a methodological conception of economics which is open to and even requires the use of philosophy and other social sciences as psychology. (Section 3).

2. Analyzing an economy subject to change with a theory of rational behavior

In this section, we will analyze the methodology used by Keynes to study behaviors in situations of uncertainty. To do so, we will first define the characteristics of the decision-making environment associated with the Keynesian notion of an “economy subject to change”. As we shall see, this complex environment makes it difficult to use traditional tools and methods of analysis to study individuals’ economic decisions (2.1). We will then analyse the methodological choices made by Keynes to define a theory of rational behaviour in a situation of uncertainty, compatible with this complex and changing environment (2.2).

2.1. Ontological uncertainty, nonergodicity and probabilities in an economy subject to change

As noted above, Keynes drew a sharp distinction between the analysis of decision-making in traditional theory and the conditions faced by decision-makers in the real world. For Keynes, the characteristic feature of a relevant theory of decision-making under uncertainty is the recognition of the importance of distinguishing between risk and uncertainty. To understand this theory, it may be useful to recall the distinction he makes in the 1937 *Quarterly Journal of Economics* article between events that are uncertain and events that are only probable: “By ‘uncertain’ knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty... The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention... About these

matters, there is no scientific basis on which to form any calculable probability whatever. We simply do not know". (Keynes [1973c] [1937], p. 113-14)

Keynes even denies the possibility of describing the game of roulette as being uncertain even though it is the most common example of uncertainty cited by traditional theory. The crucial point for Keynes is the inadequacy of statistical quantification in the form of a probability for the analysis of uncertainty since "human decisions affecting the future, whether personal or political or economic, cannot depend on strict mathematical expectation, since the basis for making such calculations does not exist" (*GT*, p. 162-3). Keynes clearly stated his view on this fundamental limitation of orthodox (i.e. "classical") economic theory in an exchange with Townshend¹: "*I think there is a great deal to be said for your view that the classical theory is not valid on any assumptions, and that you have put your finger on the spot in saying that they are trying to describe a world in which risk exists without uncertainty*". (Keynes [1979] [1937], p. 258)

Keynes thus considered "classical" economic theory as having reduced the analysis of behavior under uncertainty to the special case of risk in which there exists a well-defined probability distribution with a complete set of possible future outcomes and associated relative frequencies. He sought to develop an original approach aiming at encompass the theory of decision-making under conditions of risk within a more general theory that allowed for a broader conception of uncertainty. The interest – and the difficulties sometimes encountered by commentators – in interpreting the uncertainty in the sense of Keynes is that it has both an ontological and an epistemic dimension².

The *ontological* dimension relates to the nature of the real causal structure with which the choice situation is concerned. Uncertainty stems from the complex and unstable configuration of the universe itself. This dimension is emphasized by Keynes throughout his work. In the *Treatise on Probability* (Keynes ([1973a], [1921]), hereafter *TP*), he highlighted the fact that "*states of the universe, identical in every particular, may never recur*" (*TP*, p. 286), or that "*although nature has her habits, due to the recurrence of causes, they are general, not invariable*" because "*the possible contingencies are too numerous*" (*TP* p. 420). Likewise, in the *General Theory*, he takes up this idea by pointing out that "*the outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield have to be made.*" (*TG*, p. 165). Similarly, when considering the investment, Keynes points out that "*there is not one of the above factors which is not liable to change without much warning, and sometimes substantially. Hence the extreme complexity of the actual course of events.*" (*TG*, p. 254).

This form of uncertainty has been the subject of much work by economists whom Coddington [1976] described as "Fundamentalist Keynesians", including so-called "Post-Keynesian economists" as Joan Robinson, George

1. See Zappia [2015] for an in-depth analysis of the correspondence between Keynes and Townshend and the importance of this correspondence to understand Keynes' critique of Benthamite calculus used by classical economists and the persistent desire shown by Keynes to offer a positive alternative to this approach.

2. On this point, see for instance Dequech [1997] and the intense debates between Davidson and O'Donnell in the *Journal of Post Keynesian Economics* (O'Donnell [2015]; Davidson [2016]).

Shackle, Paul Davidson or Jan Kregel. They have adopted the terms “true” or “fundamental” uncertainty to identify the definition of uncertainty originally formulated by Keynes. They have sought to characterize the conditions of its existence by referring to notions such as “historical time” and “crucial decision-making”.

Thus “Post-Keynesian theory... is concerned primarily with the depiction of an economic system expanding over time in the context of history” (Eichner and Kregel [1975], p. 1294, emphasis in the original) so that time is “*a real-world device which prevents everything from happening at once*” (Davidson [1980], p. 158). In fact, since the basic economic decisions concerning production and investment are processes that take time and are essentially irreversible, they are said to take place in historical or calendar time. Decisions that lead to actions that cannot be reversed or repeated to produce more desirable outcomes are called “crucial” decisions. In the “neoclassical” approach, in contrast, either time takes the form of a logical and thus a reversible process, or agents are simply discovering an already known future; their actions cannot determine the future. Consequently, when these issues are treated in the traditional perspective, it is in terms of probabilistic risk, since true uncertainty as defined by Keynes is not considered.

Shackle was the first to note that historical time implied what he called “crucial” decisions: an agent faces a crucial decision when he “*cannot exclude from his mind the possibility that the very act of performing the experiment may destroy forever the circumstances in which it is performed... Crucialness is the real and important source of uniqueness in any occasion of choosing*” (Shackle [1955], p. 6 and 63). In other words, crucial decisions describe situations in which the act of taking a decision destroys the existing distribution functions so that a crucial decision that cannot be repeated³.

Among Post Keynesians Davidson [1982-83, 1991] has argued that these two characteristic features of uncertainty in the “real world”—historical time and crucial decisions—imply that the stochastic process that generates real world events is “non-ergodic”. An ergodic process is one for which time and space averages are equal; what happens at points in time for different initial states coincides with what happens over time for a given initial state. This suggests that over time economic processes follow averages that can be discovered by rational agents, thus implying the possibility of rational expectations. In contrast, Davidson argues that agents would be truly uncertain in conditions of non-ergodicity.

The identification of Keynesian uncertainty to a world characterized by non-ergodicity of economic time series generally leads fundamentalist Keynesian economists to reject the relevance of the rational expectations hypothesis. Indeed, under non-ergodicity conditions, sampling from the past

3. “An experiment can be such that... the making of it will radically alter the situation... so that it will subsequently be impossible... to perform another experiment of a relevantly similar kind. Napoleon could not repeat the battle of Waterloo a hundred times in the hope that, in a certain proportion of cases, the Prussians would arrive too late. His decision to fight on the field of Waterloo was what I call a crucial experiment... Had he won, repetition would... have been unnecessary; when he lost, repetition was impossible”. (Shackle [1955], p. 25)

in the manner implied by the rational expectations theorists is not rational since, even if agents have the possibility to assemble and process all the relevant information pertaining to past and present outcomes, the future course of events will still not reveal itself.

Moreover, the rejection of the hypothesis of rational expectations is often accompanied by an outright rejection of probabilistic reasoning for studying economic decisions. In particular, Davidson considers that, "*when agents make crucial decisions they necessarily destroy any stochastic processes that may have existed at the point of time of the decision*" ([1982-83], p. 192). This implies that in conditions of non-ergodicity "objective probability structures do not even fleetingly exist, and a distribution function of probabilities cannot be defined" (Davidson [1991], p. 132). In other words, for Davidson, uncertainty is seen as opposed to probability and probabilities represent knowledge for when probabilities are available, uncertainty disappears: only probabilistic knowledge exists, never probabilistic uncertainty: "*In the ergodic circumstances of objective probability distribution, probability is knowledge, not uncertainty!*" (Davidson [1991], p. 132)⁴. In the same vein, Shackle underlined that the representation of uncertainty by means of probability is problematic because, on one hand, it may not be feasible to portray the set of future possible realizations (Shackle [1972], p. 23) and on the other hand, the decision to invest is a crucial decision that cannot be repeated. The distant future is "essentially a void" (Shackle [1974], p. 36) and investments are subject to large and sudden revisions in profit expectations, and market valuations of assets (bonds and shares) are subject to violent shifts in market sentiment far beyond the reach of probabilistic calculation. Each reasoner has a distinct subjective framework, a "*personal intellect background, temperamental constitution, educational history*" (Shackle [1972], p. 389) and so on. He preferred to view investment decisions as "irrational... or -non-rational" (Shackle [1967], p. 130).

These conclusions have often led a large number of economists to identify Keynesian uncertainty with radical subjectivism, and the associated scientific and theoretical nihilism. This is clearly the interpretation of Keynes adopted by Lucas, who writes that "*in cases of uncertainty, economic reasoning will be of no value*" (Lucas [1981], p. 224). The most widespread opinion on the question is well summed up by Walliser ([1985], p. 17), who writes that Keynes's ideas on uncertainty have "*remained at the pre-formal stage, they do not seem to have had any general "cultural" influence on economic thinking except as complications or useless subtleties*". As a result, in the contemporary literature Keynes's analysis is either criticized or credited as an approach to macroeconomics that is incompatible with the traditional concept of individual behavior based on the assumption of economic rationality. The widely shared position within contemporary mainstream approaches, whether classical or Keynesian in inspiration⁵, is (1) that individuals' decisions must be analyzed in an environment of probabilistic

4. For a more in-depth discussion of this question, see O'Donnell [2014].

5. We refer here to the works of New Classical Economics and New Keynesian Economics, both of which adopt the rational expectations hypothesis to analyze behaviors in situations of uncertainty.

risk and (2) that this environment is the only one that can guarantee a relevant analysis of the individual rationality embodied by the rational expectations hypothesis.

2.2. Epistemic uncertainty, logical probability and rational choices in a complex decision-making environment

Contrary to the limitations and criticisms presented above, we believe that a careful rereading of Keynes' work shows that the existence of true uncertainty and a non-ergodic environment are not synonymous with irrationality or theoretical nihilism. In Keynes' approach, the complexity of the decision-making environment of an economy "*subject to change*" is compatible with an original and coherent theory of individual rationality. This approach is based on a specific theory of probability which relies on an "epistemic" conception of uncertainty. The epistemic dimension relates to the decision-maker's knowledge and understanding of the real causal structure with which the choice situation is concerned. This theory is based both on the notion of logical probability he developed in his *TP* and on the specific form of rationality studied in the *GT* and to which he refers in his 1937 *Quarterly Journal of Economics* article.

We thus believe that there is a real coherence and continuity on this subject in Keynes' work, which to some extent links our work to the "continuity-or-change?" debate on the unified and coherent nature of the author's approach. Some researchers (Bateman [1987], Davis [2009]; Gillies [2003]) argue that there is radical discontinuity between the Keynes of the *TP* and the author of the *GT*. One Keynes would praise the rational reasoning in terms of probability and the other Keynes would praise the irrationality of subjectivity and psychology. Our position is closer to that of authors like O'Donnell [1989, 1990], Carabelli [1988], Gerrard [1994] or Runde [1994] who argue that there is continuity in the development of Keynes' analysis of rational behavior from his early work on probability and rational belief in the *TP* to his analysis of economic choices under uncertainty in the *GT*. In other words, the positions considering on the one hand that there is theoretical discontinuity between the *TP* and the *GT* and that on the other hand the behaviors described in the *GT* are purely subjective or irrational don't seem relevant to us.

To show this, it is useful to re-examine, the very nature of probabilities that can – according to Keynes – be used in a relevant way for studying individual decisions. We have already noted that Keynes did not embrace the frequency theory of probability. Further, as well as being more subtle, Keynes's approach to subjective probability was also critical.

In contrast to the usual frequency theory of probability, Keynes viewed probability as a logical relationship between propositions rather than between event states of the world. Keynes is concerned with "logical probability" or the "degree of confirmation" or the "degree of rational belief".

The problem that Keynes tries to solve is the manner in which individuals determine their "rational beliefs" concerning a proposition when their knowledge of a proposition is not certain; thus in the *TP*, Keynes noted that "in as much as it is always assumed that we can sometimes judge directly that a conclusion follows from a premiss, it is no great extension of this assumption to suppose that we can sometimes recognise that a conclusion partially follows from, or stands in a relation of probability to a premiss." (*TP*, p. 56).

This line of thought suggests that there might be a logical theory of partial entailment generalising the usual theory of full entailment which is found in deductive logic: "Let our premises consist of any set of propositions h , and our conclusion consist of any set of propositions a , then, if a knowledge of h justifies a rational belief in a of degree α , we say that there is a probability-relation of degree α between a and h . This will be written $alh = \alpha$." (*TP*, p. 4).

So a probability is always associated to a degree of a partial entailment. Keynes further makes the assumption that if h partially entails a to degree α , then, given h , it is rational to believe a to degree α . For Keynes probability is a degree of *rational belief* not simply a degree of *belief*.

The original conception of probability proposed by Keynes in the *TP* is particularly adapted to the analysis of economic decisions under uncertainty within an economy subject to change. Indeed, he defines a classification linking different kinds of decision-making environments – and their respective degree of uncertainty – to specific forms of rationality characterizing each of these degrees of uncertainty. This classification is based on the identification of three main forms/degrees of uncertainty.

The *first form of uncertainty* refers to situations in which the probability, that is the degree of rational belief alh is less than one ($\alpha < 1$). For Keynes, in this case it is possible to calculate a probability by formulating a secondary proposition concerning the primary proposition that, say, an investment in a particular project will produce a particular return given the information contained in h .

In situations of this first type of uncertainty, every economic agent confronting the same situation (and with the same mental capacity) should have the same degree of rational belief and should act on this in exactly the same way. A difference in behavior could arise only from subjective differences associated with each individual, including differences in their evaluation of the information in h . Although such a situation is characterized by an inability to calculate a statistical probability based on a frequency distribution, Keynes classifies it as a decision based on a degree of rational belief that is less than perfectly certain. *It is not a question of subjective caprice or of any kind of irrationality*. Although in one sense the probability-relation is objective and any person operating from the same knowledge base will arrive at the same secondary proposition, in another sense it is subjective because knowledge/evidence varies across individuals and over time, and the rationally justifiable degrees of belief in a given conclusion will change accordingly. Probabilistic knowledge cannot be defined in terms of absolutes. Just as our estimates of probability are relative to our knowledge of other propositions, they are also relative to our capacity for logical insight (*TP*, 18-19).

This first form of uncertainty for which it is possible to construct a rational degree of belief based on experience and knowledge clearly refers to the

analytical framework of short-term anticipations in the *General Theory*. Indeed, learning by experience requires enough repetitiveness to allow agents to observe and understand phenomena. It also requires that the degree of complexity of the experience itself be not excessive lest agents will not understand the nature of the experiment and draw its lessons. The short-term expectations framework perfectly meets these conditions since: “[T]he process of revision of short-term expectations is a gradual and continuous one, carried on largely in the light of realized results” (GT, p. 50). Experience guides these expectations because “[i]t would be too complicated to work out the expectations de novo whenever a productive process was being started; and it would, moreover, be a waste of time, since a large part of the circumstances usually continue substantially unchanged from one to the next” (GT, p. 51). The missing premises in the case of production decisions are not, under normal conditions, impossible to visualize with some assurance: “For production decisions, the premises are safer, formal logic can dominate expectations formation, and the possibility of induction is preserved” (de Carvalho [1988], p. 79).

Keynes identifies a *second type of uncertainty*. This situation corresponds to the possibility of the *non-comparability* of the probabilities associated with the secondary propositions. The primary reason for this is that the facts of experience that are incorporated in h can be extremely heterogeneous or even non-existent. This provides the basis for Keynes’s affirmation that “our knowledge of the factors which will govern the yield of an investment some years hence is usually very slight and often negligible. If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence [of an investment] amounts to little and sometimes to nothing” (GT, p. 149-50). In other words, it will often be the case that it will be impossible to place an *ordinal* measure on the probability in question.

To deal with the uncertainty induced by the non-comparability of probability, Keynes introduces another essential element in his theory of logical probability: the weight of the argument, exposed in Chapters 6 and 26 of the *TP*. The weight of an argument is a measure of the amount of evidence, h , on which a proposition is based. It provides a measure of the well-foundedness of non-conclusive arguments. Arguments of high weight are based on much information, are well-founded and hence merit high degree of confidence, regardless of whether their probability is high or low⁶.

The notion of weight of argument is crucial to differentiate Keynes’ decision theory from that of classical theories, whether they are objectivist *à la* Morgenstern and Von Neumann or subjectivist *à la* Savage. The latter are in fact valid only when we reason with a weight of argument equal to one, *i.e.* at its maximum level, which corresponds to simple situations of risk or to what Vercelli [2001, 2016] calls situations of “weak uncertainty”. In this decision-making environment, the only forecasting errors of decision-makers are due to stochastic errors that are by nature unpredictable, while expected systematic errors are excluded from the field of possibilities⁷. On

6. For a more in-depth analysis of the weight of argument, see, for example, Runde [1990].

7. This is implied by a crucial axiom called the “axiom of independence” by Morgenstern and Von Neumann and the “sure thing principle” by Savage. See Vercelli [2010, 2016].

the contrary, the possibility highlighted by Keynes of situations where the weight is between 0 and 1, between the two extremes – the simple stochastic risk and the situation of complete relevant ignorance – makes it possible to take into account and analyze learning behaviors aimed at increasing the weight of argument in order to decrease the level of ignorance and reduce the expected systematic errors.

The nature of the rationality adopted by economic agents in front of this type of uncertainty can also be enlightened referring to the approach proposed by O'Donnell [1990]. He emphasizes that the *TP* is constituted by two distinct domains of analysis. The first domain is called the "determinate domain". In this case, economic agents have a "strong rationality". Within this domain, determinate answers are available to the questions posed, and human reason is strong in the sense that it can provide such answers. Examples of determinacy are the following: probabilities are known because "*agents have sufficient logical insight; probabilities are comparable because they belong to the same series; the weights of arguments are comparable; and probable values may be ordinally ranked because agents can form judgments combining nonnumerical probabilities with (possibly) non-numerical values*" (O' Donnell [1990], p. 257).

The determinate domain of the *TP* thus encompasses both short term expectations of the *GT* and also long-term expectations with relatively high weight. In all these cases, "*human rationality is patent because it generates definitive answers, which lay claim, in Keynes's scheme, to objectivity and truth*" (*ibid.*, p. 257).

This kind of rationality can be found in Chapter 12 of the *GT*. Indeed, when Keynes evokes the role of confidence in the decision to undertake an investment, it is precisely the "weight of the argument" that he has in mind (*GT*, p. 148-49). Thus, when probabilities cannot be compared and it is impossible to formulate a rational belief, it is the weight of the argument which becomes the determining factor, that is, which allows the evaluation of investment alternatives that produces a final decision to act. The subjectivity that resides in the evaluation of different individuals may then become dominant, since it is individual experience that will determine the weight that will be assigned to new information. As Kregel pointed out ([1987], p. 526), it is only at this point that the idea of "animal spirits" enters into the decision-making framework of the *GT*. Animal spirits will be the final determinant of the moment at which the weight of the argument attached to a proposition is sufficient to make it dominant over all other possible propositions. They thus represent, in Keynes's words, the "spontaneous urge to action rather than inaction". It is important to note at this point that Keynes insists that this "spontaneous urge to action" does not depend on "waves of irrational psychology" (*GT*, p. 162), but rather that this type of decision is securely founded in "rational spirits" (Kregel [1987], p. 526), by "*our rational selves choosing between the alternatives as best we are able, calculating where we can, but often falling back for our motive or whim or sentiment or chance*" (*GT*, p. 163).

Another interesting and more contemporary application of the rationality used within the determinate domain is provided by the approach of Hyman P. Minsky, whose ideas were brought to the forefront during the financial

crisis of 2007. Although rarely emphasized by commentators⁸, the theory of financial instability he develops is based on a form of rationality strongly inspired by the concepts of and methodology present in the *TP*. This is not surprising inasmuch as Minsky's references to *TP* are present in his work from the 1970s. For him, there is undeniably a very strong influence of *TP* on *GT*: "In interpreting *The General Theory* it should be kept in mind that Keynes was first the author of a *Treatise on Probability*" (Minsky [1975], p. 67) and *TP* provides relevant tools for the analysis of decisions in situations of uncertainty: "Keynes held that there was no way of replacing this uncertainty with certainty equivalents, and furthermore that the relevant probabilistic propositions and the weight attached to such propositions change, not in a random or unpredictable manner, but in a consistent manner in response to events" (Minsky [1975], p. 66)⁹.

It is on the basis of this theoretical background that Minsky analyses the behavior of banks. Minsky's bankers will typically seek to assign a degree of rational belief to a primary proposition (conclusion) as of the type: "the borrower is a good credit risk". Included in the information set, *h*, will be the credit history of the borrowers. Here we clearly find the influence of the *TP* where the determination of the logical probability – that is to say of the degree of rational belief assigned to a proposition – is a function of the objective data drawn from experience.

To this objective factor influencing the formation of banks' expectations, there is an added subjective component. It implies that realized outcomes (for example, the quantity of loans that has been repaid) can induce banks to modify their decisions as to the amount of credit to be granted, independently of how these outcomes fit in with their expectations. This means that, even if results merely confirm the banks' expectations, it is likely that, encouraged by increased confidence in their forecasting methods, they will make more loans. Accordingly, the longer the period during which the debt to equity ratio of the economy remains at a certain level without provoking a financial crisis, the more banks are likely to raise their estimates of the maximum level of indebtedness (in proportion to the value of assets both they and potential borrowers hold) to which it is prudent to agree. In Minskyan terms, this means an erosion of the "margins of safety" required by banks.

Here again, the reference to the concepts of weight of the argument of the *TP* and state of confidence of the *GT* is striking. More precisely, as a period of expansion goes on, the amount of positive information in *h* increases and in doing so increases the weight of the argument in favor of accepting the conclusion *a* as a correct assessment of borrowers' creditworthiness. But, as the expansion goes on, there are more and more "good credits" who represent acceptable margins of safety. In periods of boom, these margins may

8. With the notable exception of Kregel [1997] and Nasica [2010].

9. Finally, it is striking that the reference to the "degree of rational belief" of *TP* is still highlighted in Minsky's most recent article published the year of his death: "Uncertainty viewed as the result of the degree of rational belief in the models that underlie action is central to those parts of *The General Theory* in which the determination of the prices of capital assets and of liability structures for financing positions in capital and financial assets are taken up." (Minsky [1996], p. 358).

thus be set at levels that are too low to effectively protect the balance sheet because investors and financial institutions believe that risks are in reality low.

Thus, the banker become more confident, without any necessity for euphoria or excessive optimism. All these behaviors are neither irrational nor myopic. As banks have to take their decisions in a situation of true uncertainty, they are led to adopt behaviors that are rational in this type of environment, *i.e.* behaviors similar to the ones described by Keynes in the *TP* and the *GT*. In the determinate domain, it consists in mixing an objective part, linked to experience and objective observations, and a more subjective, but equally rational part, linked to the weight of argument/state of confidence. It is in this context that financial fragility highlighted by Minsky builds up endogenously and rationally in the expansionary phase of a business cycle.

Finally, Keynes highlights a *third situation of uncertainty*. This appears when the weight of argument is very weak, or even non-existent, which involves the impossibility of obtaining a *cardinal* measure of the probability. Far from being rare, Keynes considered this the most likely case whenever expectations were formed over the long period. This point of view appears very clearly in the *TP*, which contains successive warnings against what Keynes calls "numerical expression" (*TP*, p. 21-22). Notably, he points out that:

[i]t has been assumed hitherto as a matter of course that probability is, in the full and literal sense of the word, measurable. I shall have to limit, not extend, the popular doctrine... The calculus of probability has received far more attention than its logic, and mathematicians, under no compulsion to deal with the whole of the subject, have naturally confined their attention to those special cases... where algebraical representation is possible (ibid.).

Keynes thus considered that the possibility of obtaining a numerical (cardinal) measure of the degree of probability as only occasionally possible: "A rule can be given for numerical measurement when the conclusion is one of a number of equiprobable, exclusive, and exhaustive alternatives, but not otherwise" (*TP*, p. 122).

Now, in most situations concerning decisions with long period consequences, this is far from realized. It then becomes very difficult to endogenize the process of expectations formation and, as Keynes notes, "the state of long term expectation [...] cannot be inferred from the given factors" (Keynes [1973d] ([1934], p. 480) so that these decisions must be considered as *being taken outside* the "realm of the formally exact" (*GT*, p. 2).

Economic agents have now to face a new decision-making environment corresponding to what O'Donnell calls the second or "indeterminate" domain of the *TP* where "probabilities are unknown for want of reasoning power; it is theoretically impossible to compare probabilities; weights are also non-comparable; and agents are unable to combine probabilities and values where either or both are non-numerical" (O'Donnell [1990], p. 257). For O'Donnell, the existence of an indeterminate domain was already recognized by Keynes in the *TP*, even though it was relegated to a subordinate position and its implications never explored in detail. But after the *TP*, how-

ever, Keynes's priorities changed, with increased significance being given to this non-determinate region.

Of course, in this situation strong rationality is impotent. However, for Keynes, the inability to apply strong rationality in certain circumstances does not imply the adoption of irrational behavior. Economic agents will follow a form of "weak rationality" consisting in developing strategies and responses different from those adopted in the determinate domain.

More precisely, Keynes suggests that the optimal behavior to be adopted by decision makers is to fall back on their common sense as reflected in "the actual observation of markets and business psychology" (*GT*, p. 149) rather than on the calculus of probability. Thus, entrepreneurs will first consider their past experience, and may presume that "*the most recently realized results will continue, except in so far as there are definite reasons for expecting a change*" (*GT*, p. 51.) This initial response comes to the same thing as adopting an extrapolative behavior that gives the present and the recent past an equivalent role to that which they play in the short period. In the second place, conscious of the lack of information and of the reliability of their individual judgements, entrepreneurs may adopt a conventional attitude: by doing so, they will "*fall back on the judgement of the rest of the world which is perhaps better informed in such a way that behavior permanently conforms to that of the majority or the average and the psychology of a society of individuals each of whom is endeavoring to copy the others leads to what we may strictly term a conventional judgement*" (Keynes [1973c] [1937], p. 114). It is against this background that Keynes's remark that "*in practice we have tacitly agreed, as a rule, to fall back on what is, in truth, a convention*" (*GT*, p. 152) should be interpreted. Finally, entrepreneurs may admit that the "existing state of opinion" as expressed by the evaluation of the market is the only one that should be considered the "correct summing up of future prospects" for investment (Keynes [1973c] [1937], p. 114). But included in this market evaluation will be "*all sorts of considerations... which are in no way relevant to the prospective yield*" (*GT*, p. 152). In fact, in these conditions the calculations of agents count for less than their "*nerves and hysteria, and even digestions and reactions to the weather*" (*GT*, p. 162). It thus becomes easier to understand why long-run expectations, and thus the marginal efficiency of capital, can be considered as being subject to sudden, sometimes violent, changes, marked by waves of optimism and pessimism.

Nevertheless, it is important to point out that although Keynes agreed that markets actually adopt conventional expectations, he never accepted them as a general rule. In particular, for Carabelli and De Vecchi [2001], even in situations of strong uncertainty, economic agents can form what the authors call "reasonable expectations" which they distinguish from "conventional expectations". According to them, Keynes considered conventions as an artificial means by which economic agents rationalize uncertainty only in cases of total ignorance. On the other hand, the existence of a limited knowledge, however small it may be makes it possible to use an autonomous reasonable judgement that guides action. Within this context, "*reasonable expectations are not grounded on rules, but on logical probabilities, i.e. upon 'real', limited knowledge or upon reasons in which we 'really*

believe' (Carabelli and De Vecchi [2001], p. 280)¹⁰. In other words, the "reasonable" economic agent, when able of doing so, should base his expectations on his own personal judgement independently of traditional judgements and conventions. He can do this by taking advantage of all the limited "real" knowledge available to him.

Interestingly, conventional and reasonable expectations coexist in Chapters 12 and 13 of the *GT* where Keynes describes actual markets, with agents characterized by different degrees of limited knowledge. Some agents are ignorant, *i.e.* they lack judgement or even limited knowledge, or they are operating in situations where logical probability is intrinsically inapplicable. Others are "skilled" agents, *i.e.* they are "expert professionals" who possess "judgement and knowledge" (Keynes [1936], p. 154, 156): they are the short-term speculators and the long-term investors (entrepreneurs).¹¹ In the *GT*, the speculative motive is defined as "the object of securing profit from knowing better than the market what the future will bring forth" (Keynes [1936], p. 170). Speculators do not follow conventions but are concerned with "*foreseeing changes in the conventional basis of valuation a short time ahead of the general public*" (Keynes [1936], p. 154). In other words, speculators follow "probable" knowledge in trying to anticipate market conventions: the continuity of the *GT* with the *TP* is apparent.

Thus, in Keynes' approach, even in the most extreme conditions of uncertainty, behaviors based on a probabilistic analysis are quite possible and will be rationally adopted by the most skilled agents. The foundations of this analysis are mainly developed in chapters 3, 15, 17 and 26 of the *TP* as well as in the correspondence he had with Hugh Townshend between 1936 and 1938. In the Chapter 26 of *TP* dealing with the "Application of probability to conduct", Keynes proposes a theory of "non-numerical" or "numerically undetermined" probabilities. More precisely, he seeks to establish a numerical measure of a relation of probability through the method of "numerical approximation" allowing to link non-numerical probabilities to numerical ones: "*Many probabilities, which are incapable of numerical measurement, can be placed nevertheless between numerical limits. And by taking particular 'non-numerical' probabilities as standards a great number of numerical comparison or appropriate measurements become possible*" (*TP*, p. 176). As pointed out by Zappia, "*In uncertain settings Keynesian agents are not forced to rely on 'conventions' or 'useful mental habits' as if complete ignorance would represent the entire spectrum of economic activity. [...] In trying to focus on a positive analysis of decision-making under uncertainty, therefore, one is simply adhering to Keynes's long-standing commitment to*

10. In the famous beauty contest example the contrast between conventional and reasonable expectations is apparent. Conventional expectations are formed by picking those faces which each competitor "thinks likeliest to catch the fancy of the other competitors". Reasonable expectations are formed by "choosing those [faces] which, to the best of one's judgement, are really the prettiest, [or] even those which average opinion genuinely thinks the prettiest" (Keynes, *GT*, p. 156).

11. The distinction between ignorant and skilled agents was already present in his 1910 notes on speculation (Keynes [1910]). In those notes, we find a description of actual markets based on the epistemological distinction between "gamblers" (ignorant agents) and speculators.

interpret reasonable judgement in a, surely unconventional, probabilistic set-up” (Zappia [2016], p. 855).

This relatively understudied aspect of Keynes’s theory is fundamental in more than one respect. On the one hand, it marks a clear differentiation with certain fundamentalist interpretations recalled above which exclude any recourse to probabilistic reasoning in situations of strong uncertainty. On the other hand, it offers an original analytical framework for the study of decisions in an uncertain environment, the use of non-numerical probabilities and the possibility of inexact numerical comparison making this approach very different from the strict Bayesian approach of subjectivists à la de Finetti and Savage¹².

This first part enabled us to present and clarify the impact of considering a truly uncertain economic environment on the methodology used by Keynes. For him, the complexity and non-ergodicity of the real world are not synonymous with the irrationality of economic agents and do not induce any theoretical nihilism. On the contrary, it is the integration of true uncertainty as a central element of his approach that allows him to develop a theory of economic decisions that is both original and coherent. As we have pointed out, the main originality of this theory rests on a well-argued classification of the different forms of uncertainty and the way in which they determine the specific forms of rationality associated with them: the highlighting of greater or lesser degrees of uncertainty goes hand in hand with the definition of more or less strong forms of rationality. In this framework, when uncertainty is at its highest level, and even when an ordinal or cardinal measure of probability is impossible, Keynes provides a coherent set of tools for analyzing economic decisions. Even if a measurable degree of rational belief cannot be obtained, the choices of economic agents will be rationally governed by conventional attitudes or animal spirits but also, often, by a reasoning based on the limited but real knowledge available to economic agents and even by non-numerical probabilities.

3. On the philosophical and psychological dimensions of Keynes’s theory of decision making: a different and promising approach

In the previous part of our contribution we resorted to Keynes’s writings but also to their various interpretations in order to question the predominant

12. Some works are more or less explicitly in line with Keynes’ method of approximation. Among them are Koopman [1940], Good [1950] or Smith [1961] for whom probabilities usually provide only a partial ordering and who use the notion of upper and lower probabilities. For further discussion of these issues, see Zappia [2016], Basili and Zappia [2009], Zappia [2015] and Brady and Arthmar [2012].

modern legacy of the author of the *TP* and the *GT* in the field of individual decision theory. This legacy suggests that a long intellectual work is still to be done in order to investigate more deeply its contribution and the different complexities of it (see below our developments devoted to Carabelli).

Actually a first set of traditional models or of traditional interpretations is still arguing that what is called "Keynesian macroeconomics" must be based on the usual conception of individual and rational behavior, on the basic and usual difference between risk and uncertainty and on the autonomy and self-containment of economic science. Conversely a second set rejects all or a part of these traditional assumptions, suggesting alternative ones as the prevalence of limited or organic rationality, the necessity of taking into account and distinguishing rigorously risk and uncertainty and the definition of economics as an open science.

Now the purpose of the following sections is not so much to reinforce the opposition between these two interpretative approaches. It is rather to study two crucial points. The first one (section 3.1.) is to stress how the consideration of philosophical aspects of Keynes's own writings change the usual conception of formal rationality based on individual decision theory and show how these aspects emphasize a more open and realistic conception of economic behavior. The second one (section 3.2.) analyses the central role played by the *different existing forms* of psychology in the characterization of decision making processes provided by Keynes.

3.1. Keynes, economic behaviour and philosophy

This other conception of Keynes's works is not based on economics mainly interpreted as a language. It contrasts with "classical" and modern mainstream which assume in common a closed and self-contained conception of economics based on given and exogeneous "fundamentals" (preferences, techniques and distribution norms and rules) *a priori* attributed to each atomistic and specific individual agent. Quite the contrary, it is based on the complete set of social sciences and on philosophical foundations. Therefore it is not *a priori* self-contained but open.

First of all, for the defenders of the traditional view of Keynes's economics based on a closed system, the scientific nature of our discipline is strictly connected to its strict autonomy with regard to other social sciences or to philosophy; thus any assumed form of dependence between economics and these sciences or philosophy – even limited – would indeed imply that economic "fundamentals" are no longer self-contained and do no longer exist without the help of other social sciences; therefore the so-called "microeconomic foundations" of rational choice would lose their basic importance or even disappear.

Secondly, we stressed earlier that Keynes's insistence on the necessity of a *realistic* economics implied a major difference between Keynes's and the traditional approaches of decisions in a context of uncertainty: actually the

notion of uncertainty makes no sense in this second approach; the traditional view indeed refers to a world in which the concept of computable risk is the only one which remains (see what we noted in part 1 concerning Lucas).

Thirdly, a careful read back of Keynes's writings would contradict the very coherence of the traditional approach; if economics is supposed independent from philosophy in these writings, it would indeed be necessary to find the real intellectual meaning of such a broad space devoted by Keynes to philosophy and not to ignore and cancel it.

Conversely, the "classical" and the modern mainstream Keynes's interpretations cannot be accepted when they ignore the relation of economics and philosophy even if the contents of this relation varies from one interpretation to the next. This is one of the major conclusions of part 2. For instance we could here refer to Carabelli [1988], de Carvalho [1988], Gerrard [1994], O'Donnell [1989, 1990], Minsky [1975] or Zappia [2015] who all contested the theory of rational choice with uncertainty based on a closed system. They replaced it by various interpretations of Keynes's theory of decision making; but these different interpretations could not have been built if they had not in common the definition of economics as an open science requiring specific societal or philosophical foundations of economic behavior and the choice of empirical observations allowing a characterization of the "real world".

To a large extent this opposition between both interpretations of Keynes's intellectual construction reflects the fundamental meaning of the philosophical and methodological foundations of his writings.

As we know (see Davis [2009]), Keynes's youth was first and strongly influenced by the philosophical debates which took place in Cambridge since 1820 when the *Apostles Society* was created by George Tomlinson. Now, concerning the relations of economics and philosophy, this Society allowed discussions and mutual exchanges inside or outside of it between Keynes and four major Cambridge philosophers of the XXth century who shared a part of their common academic life: G.E. Moore, B. Russell, A.N. Whitehead and L. Wittgenstein. Keynes was also aware of the contributions of H. Sidgwick, A. Marshall, and of his own father John Neville who belonged to another previous generation, which did not accept to include economics among pure natural sciences and agreed on the fact that economic science had to be built on induction, defined as an empirical generalization of well-established facts and therefore on a given and preliminary view of the "real world".

Keynes took this view into account but was more influenced by Moore and by some members of the Bloomsbury Group as R. Fry or L. Strachey for instance. He had important philosophical intellectual and constructive exchanges with them on art, science, philosophy and society.

At last, one of the differences between Keynes and Moore is related to the relation between universal and individual assertions and judgements and we will start here from it. In his 1904-1911 manuscripts, Keynes indeed criticized Moore's conceptions. In these writings, Keynes discussed in particular four Moore's issues: (i) has individual behavior to be conform to general rules?; (ii) how can we characterize the individual evaluation of a

given probability?; (iii) what is the importance of the individual capacity to make judgements? and (iv) what is the difference between individual egoism and utilitarianism?

(i) Now in contrast with Moore, Keynes refused the predominance of an universal, natural and objective rule which could govern all types of behavior. He considered that the reference to some specific information which is generally more substantial in a given context when we have to take a specific decision excludes this predominance (see Keynes [1904:19]);

(ii) Keynes noted that if probability very often implies some form of ignorance it must however also be built on some available information which is individual, cannot be ruled out and therefore will reinforce the specificity of each type of behavior;

(iii) Moreover, Keynes considered that the importance attributed by Moore to universality more than individual specificity would contribute to reinforce the ignorance and the lack of power of individuals while both ignorance and information are necessary components of a probability;

(iv) Keynes did not accept Moore's defense of the idea of a coincidence between *individual* and *universal* goods (Moore [1903:1]). For him, utilitarianism has to be carefully distinguished from egoism by individuals in relation with macroeconomic magnitudes, even if this relation does not imply at all its interpretation as an aggregation procedure. As Keynes wrote in the *French preface* of the *GT*: « *Nous avons donné à notre théorie le nom de « théorie générale* ». *Par-là, nous avons voulu marquer que nous avons principalement en vue le fonctionnement du système économique pris dans son ensemble, que nous envisageons les revenus globaux, les profits globaux, la production globale, l'emploi global, l'investissement global et l'épargne globale bien plus que les revenus, les profits, la production, l'emploi, l'investissement et l'épargne, d'industries, d'entreprises ou d'individus considérés isolément. Et nous prétendons qu'on a commis des erreurs graves en étendant au système pris dans son ensemble des conclusions qui avaient été correctement établies en considération d'une seule partie du système prise isolément* ». (Keynes [1942], p. 3-4).

This reference and the other ones show that since the first decade (in relation with Moore) to the last one of Keynes's life, the core of his approach was never a set of macro-magnitudes as such (he never used the word "macroeconomics" in his writings) but a specific open conception of individuals different from the self-contained one developed by what Keynes called "orthodoxy" in the *GT*.; this crucial characteristic obviously exclude a conception of "macroeconomics" based on *aggregation* and opened the way to a conception based on *interaction* between agents and including the concept of *complexity*. Why this difference? We noted earlier that Keynes "took into account" the idea expressed by the generation (including his own father) which preceded him, *i.e.*, the fact that economic science had to be built on logic but also on induction seen as a simple empirical generalization of well-established facts. Now this view and its reference to the "real world" exclude *formal aggregation* and requires the use of interactive agents and complex relations.

In line with part 2 it is now time to be analytically more specific, mentioning the concept of probability and the way individuals try to connect it with

economic reality: *"In the sense important to logic, probability is not subjective. It is not, that is to say, subject to human caprice. A proposition is not probable because we think it so. When once the facts are given which determine our knowledge, what is probable or improbable in these circumstances has been fixed objectively, and is independent of our opinion. The theory of Probability is logical, therefore, because it is concerned with the degree of belief which it is rational to entertain in given conditions, and not merely with the actual beliefs of particular individuals, which may or may not be rational."* (TP:4)

This quotation of the *TP* is crucial to understand the way which is used by individuals – according to Keynes – when they try to predict the future of the economic system and of its components. First it excludes the assumption of subjectivism as the theoretical foundation of individuals as it was promoted by the Austrian and the "neo-classical" traditions. For Keynes the "real world" is not determined by each individual according to his personal view and his opinion. Probability cannot be the only result of individual imagination. It is "concerned with the degree of belief which it is rational to entertain in given conditions, and not merely with the actual beliefs of particular individuals, which may or may not be rational." (TP: 4).

However, this assertion does not mean that expectations are optimal or rational as it is the case in traditional analysis. Keynes speaks of probabilities as being fixed objectively, but he is not using here the concept of objectivity to refer to things in the material world. In compliance with his view of the relation between economics and philosophy and by contrast with the "orthodox" one, he means objective in the Platonic sense, referring to the element of a supposed Platonic world of abstract ideas. This world obviously supposes the existence of an approach which explains how we may obtain knowledge about this logical relation of probability. Keynes's answer is that we get to know at least some probability relations by direct acquaintance or immediate logical intuition. As Keynes says *"we pass from a knowledge of the proposition to a knowledge about the proposition by perceiving a logical relation between them. With this logical relation we have direct acquaintance."* (TP: 13).

This "logical" and "objective" conception implied a debate between Keynes and Ramsey in which the former changed partially his view but however maintained: (i) his opposition to Ramsey's theory of subjective probabilities; (ii) the role given by Keynes to the "weight of arguments" as it was developed in the *TP*. This is why this role continued to be present after the *TP*.

As we noted earlier, Keynes then used weight both as an absolute and a relative concept. According to the former, weight is measured by the absolute amount of relevant evidence. But the latter also introduces a notion of relevant ignorance. After referring to probability as depending on the balance of favourable and unfavourable evidence, Keynes introduced actually the concept of weight as an additional respect in which arguments may be compared: *"This comparison turns on a balance, not between the favourable and the unfavourable evidence, but between the absolute amounts of relevant knowledge and of relevant ignorance respectively"* (TP, p. 77). Therefore, Keynes opened the way to the concept of confidence but also, as underlined earlier, to a weak form of rationality. According to O'Donnell, this

last type of rationality refers to modes of behavior as the “*acceptance of social conventions, customs, moral duties and rules of thumb, the following of better informed opinion, and even allowing arbitrary procedures such as pure caprice or coin tossing to decide issues*” (O'Donnell [1990], p. 257-58).

Therefore this weak form of rationality is central because: (i) it reveals the existence of a “real world” which could not have been introduced at all in the formalist traditional approach; (ii) it introduces a concept which could not have been introduced in the traditional approach since this approach neglects any possible help of philosophy; (iii) it defines a concept which is *both* logical and psychological (iv) it is both absent from the Austrian as well as the traditional approach.

In line with these arguments, in “Ramsey as a philosopher”, Keynes wrote about his colleague:

In attempting to distinguish “rational” degrees of belief from belief in general he was not yet, I think, quite successful. It is not getting to the bottom of the principle of induction merely to say that it is a useful mental habit. Yet in attempting to distinguish a “human” logic from formal logic on the one hand and descriptive psychology on the other, Ramsey may have been pointing the way to the next field of study when formal logic has been put into good order and its highly limited scope properly defined. ([1972], [1931], p. 338-39).

Therefore, for Keynes, induction remains something more than a “useful mental habit”: it is also an element of logic. This is why contrary to some of his Cambridge colleagues, he always preferred to use the expression “logical intuition” to the simple expression “intuition” used by the philosophers of the period of his father in a more empiricist way.

To precise the concepts of “logical intuition” and “real world”, let us come back again to Keynes's example of individual decision making. Why did he consider that this example is crucial? The answer is to be found in the role attributed by Keynes to uncertainty which is central if we try understanding individual economic actions. As soon as the *TP*, Keynes indeed tried to show that uncertainty is always present when we refer to time and therefore to economic dynamics. In the *TP*, he criticized the law of large numbers and the frequentist approach to probabilities since for him economics was not a *natural* but a *moral* science in connection with the Cambridge tradition. In a letter to Harrod written on the 4th July of 1938, he noted that this moral science copes essentially with introspection, values but also with motivations, expectations and psychological uncertainties. Now to understand these psychological elements, we need modelling but also a careful observation of the working of the real world, mixing statistical data, intuition, imagination and researcher common sense: now the real world is never static or repetitive. It is always moving, and unstable. Keynes therefore refers here at least implicitly to the notion of *emergence* and consequently of *complexity*: *Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world. It is compelled to be this, because, unlike the typical natural science, the material to which it is applied is, in too many respects, not homogeneous through time. The object of a model is to segregate the semi-permanent or relatively constant factors from those which are transitory or fluctuating so*

as to develop a logical way of thinking about the latter, and of understanding the time sequences to which they give rise in particular cases (...). In the second place, as against Robbins, economics is essentially a moral science and not a natural science. That is to say, it employs introspection and judgments of value (Keynes, J.M. ([1973c], [1938], p. 296).

We know the various fields considered by Keynes in the *GT* in which the example of the theory of decision making could be applied as the determinants of effective demand; the “objective” and the “subjective factors” of the propensity to consume; the “psychological and business incentives to liquidity”; or the working of financial markets. These fields would show the fundamental role played by this theory in the *GT*. The conclusions would be analogous to those of the first part of our paper. According to Keynes, one of the major limits he attributed to what he called “orthodoxy” was indeed related to its choice of defining it as a self-contained conception of economics which excluded the help of the contribution of other social sciences as psychology instance. Therefore if we insisted in this section on the relations between economics and philosophy, in the last section of our paper our remarks may be extended to other social sciences as psychology for instance.

This is also why Keynes’s self-contained conception opens the way to usual macroeconomics based on a very specific definition of rationality and individuals which excludes the analysis of real and complex economic instability. The acceptance of closed fundamentals indeed leads to both an optimal general equilibrium in microeconomics and to an aggregation procedure in macroeconomics. Then the combination of these two approaches generates a form of dynamics which distinguishes balanced growth related to equilibrium and business cycles which are the result of exogenous and stochastic disturbances excluding endogenous instability as well as structural change.

Moreover, from a more methodological point of view, in the traditional approach, individual rationality is reduced to optimization while Keynes’s one cannot be limited to it. According to Keynes, the prevalence of uncertainty excludes this reduction and obliges economists to combine two determinants through “logical intuition”. The first refers to logic and explains why modelling has its space in the objective aspect of probability. The second requires intuition namely the observation of the real world and of the causes and forms of its instability. Therefore Keynes’s view of instability is fundamentally endogenous and complex; it cannot be eliminated or reduced to equilibrium, balanced growth or exogenous business cycles.

This crucial emphasis on complexity in Keynes’s works has been very precisely and convincingly generalized, stressed and analyzed by authors as Marchionatti [2010] and Carabelli ([1988] and [2012]). First, “complexity and incommensurability (which Keynes often treats as synonymous) of magnitudes is absolutely crucial in Keynes’s way of reasoning in economics and in his philosophy of measurement (see Carabelli [1992, 1994, 1995]). His works are literally full of references to various complex and incommensurable magnitudes” (Carabelli [2012]:87).

Secondly, in contrast with “classical” approach, Keynes’s complexity excludes various “fallacies” as for instance the “fallacy of independence

(when reductionism is applied to a complex economic material)", "the fallacy of composition (when conclusions about a whole are arrived at by analyzing parts of it in isolation; partial equilibrium analysis, in Keynes's view, suffers from this fallacy)", (...) "the fallacy of homogeneity (when treating heterogeneous magnitudes as if they were homogeneous)" and "false analogies (such as those related to the use of statistical inference in econometrics, or the shaping of conventional expectations on the market – "market idola")." (Carabelli [2012]: 82).

Thirdly, Carabelli's emphasis on complexity also allows to avoid the risk of reductionism in the non-traditional interpretation of Keynes's view of economic decisions. Let us take the example of Keynes's crucial concept of "reasonableness": "Reasonableness is based on a non-demonstrative logic and on intuition versus psychology and behaviourism. But reasonableness must not be confused with following habits, rules and market conventions: Keynes defends partial knowledge against mere experience. This is why Keynes's suggestion differs from Marshall's and Hayek's "follow rules, routines and conventions". Only in a situation of uncertainty (radical ignorance, very low weight of argument or confidence) and of incommensurability of magnitudes, rules, routines and market conventions may play a role and be reasonably justified." (Carabelli, *ibid*, 91; see also Zappia [2015] on this theme).

Another example can also be found in Keynes's various contributions dedicated to probability measurement and comparison. Again, Carabelli [1994] dedicated an excellent paper and a convincing argumentation to this theme, insisting on Keynes's "philosophy of measure" (*ibid*. 21) and on the absolute necessity of relating economics and philosophy to understand the meaning of Keynes's fundamental contribution.

Let us now consider more carefully another inter-disciplinary dimension based on *Keynes's view of psychology* to see whether it reinforces our first reinterpretation of Keynes's approach.

3.2. Keynes, economic behaviour and psychology

The previous section of our paper highlighted the importance of the role of logic and philosophy in the context of Keynes's process of individual decision making. In spite of the differences between his social philosophy and those of Moore and Russell, Keynes was certainly influenced by both of them with regard to the fundamental contribution of logic to philosophy.

As we already noted, Keynes however never reduced the issue of decision to a purely logical problem as the traditional economic analysis did. As we also argued, being a "moral science" for him, it also coped with "motives, expectations, psychological uncertainties" (Keynes [1973c]: 300). Now, we already stressed that for him these motives, expectations and psychological aspects provide the source of uncertainty as well as permanent change and instability. This is the meaning of Keynes's remark according to which to

explain the origin of this change and this instability, the economist must mainly try to “segregate the semi-permanent or relatively constant factors from those which are transitory or fluctuating” (Keynes, *ibid.*: 296-7). The origin of this distinction between two types of “factors” is not technical or mainly based on optimization. It is primarily psychological: “In ethical calculation each individual’s momentary state of mind is our sole unit. In so far as a state of mind has parts, to this extent I admit the principle of organic unities [as Moore did it – RA and EN]: it is the excellence of the state as a whole with which we are concerned. But beyond each individual the organic principle cannot reach” (Moore’s “organic principle is here contested in line with Keynes’s definition of individuals – RA and EN – extract of unpublished “*Miscellanea Ethica*”).

Among the “parts” of the “state of mind”, some are therefore constant as logical calculus or judgements and other ones – being psychological or sometimes inter-psychological – are permanently changing and contributed to the explanation of economic changes and economic instability. Both these concepts are related to individuals or to inter-individual interactions – as various types of expectations (related to demand for money, investment and production); wage partial rigidity; animal spirits; money illusion; conventions; or the state of confidence for instance. They provide the psychological illustrations and foundations of Keynes’s economic analysis. They fundamentally differ from the formal assumptions of “neoclassical economics”. It is indeed obvious that the imposition of optimizing rationality as the decisive criterion, *i.e.*, obeying some specific axioms, does not conform for Keynes to how people actually behave in the real world: these assumptions indeed exclude any help of the contributions of psychology.

Therefore, as we already noted, the reasons why Keynes left such a large space to psychology and rejected the traditional analysis are also related to the issue of economic dynamics. On one side, Keynes never accepted the introduction of simple extrapolative or adaptive expectations, apart in the cases of certainty or very short periods. This type of expectations is indeed incompatible with an economic analysis which attributes a major importance to future and expected economic change, in the short as well as the long period: “Although output and employment are determined by the producer’s short-term expectations and not by past results, the most recent result usually plays a predominant part in determining what these expectations are. It would be too complicated to work out the expectations *de novo* whenever a productive process was being started; and it would, moreover, be a waste of time since a large part of the circumstances usually continues substantially unchanged from one day to the next”. (*GT*: 51).

This is why mental habits and psychological factors cannot be neglected in a changing world: “It would be foolish, in forming our expectations, to attach great weight to matters which are very uncertain. It is reasonable, therefore, to be guided to a considerable degree by the facts about which we feel somewhat confident, even though they may be less decisively relevant to the issue than other factors about which our knowledge is vague and scanty. (...) our usual practice being to take the existing situation and to project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change.” (*ibid*: 148).

As it is the case for logic, another social science is therefore necessary here for Keynes to help economics to explain decision making in the real world. This conclusion is not so surprising too since it also reveals the limits of traditional theory concerning dynamics and uncertainty.

What kind of psychology, by the way, can be used by economists if we focus on Keynes's approach? The first is certainly *cognitive psychology* in which Keynes included logical intuition (see Mini [1994]; Almeida and Curado [2019]). The second is *social psychology* and focuses on social interactions as conventions, herd behavior or emotional contagion, for instance (see Barnett [2013]; Koutsobinas [2004]). The third is *Freudian psychology* (see for instance Winslow [1986]; Dostaler and Maris [2009] or King [2010]).

To-day however the situation is somewhat different. Besides the optimizing behavior of modern "neo-classical" approaches, traditional behavioral psychology and behavioral game theory gave birth to *behavioral economics* and the issue of the relation between this new form of economics and Keynes's thought became present in modern literature. Why is it the case?

First because optimizing behavior is still present as a benchmark in behavioral economics (*BE*) after having played a crucial role in traditional analysis even if this role is very different. Many contemporary economists are to-day satisfied to be able to use renewed and more realistic microeconomics without being compelled to forsake individual optimization. Secondly because with time *BE* is becoming more and more interdisciplinary attributing a specific and more precise role to psychology. Thirdly because *BE* acquired a growing propensity to be more open than traditional analysis to economic dynamics. These are the reasons why more and more papers to-day are dedicated to the relation between behavioral economics and the economics of Keynes (see for instance Baddeley [2013]; Davidson [2011]; Fung [2006], [2010] and [2011]; Pech and Milan [2009]; Schettkat [2018]). We will not investigate here in detail this literature which is still in progress and under ongoing discussion to understand if *BE* provides a possible renewal of standard economics or a possible emergence of a new form of economics.

What we will argue is only to briefly mention some of the psychological developments utilized by *BE* to try to provide some significant analytical foundations of Keynes's economic analysis. These developments are mainly related to the *GT*: "useful mental habits"; fundamental uncertainty; status quo bias; overconfidence; conventional behavior; the role of animal spirits in carrying out investment plans; herding behavior; conformity; use of heuristics in decision making; marginal efficiency of capital; existence of nominal rigidities; money illusion; financial instability; recurrent unemployment; cyclical fluctuations; speculative spurts; irrational waste of resources. They play a major role in the *GT* and cover a considerable part of the book. A very well-done presentation of these developments with *BE* is to-day available in contributions as Davis [2009], Muchlinski [1998], Pech and Milan [2009] or Runde and Mizuhara [2003].

These developments were also mentioned by Akerlof who noted when he connected *BE* to Keynes's approach presenting his project as an initial "dream":

"That dream was the development of a behavioral macroeconomics in the original spirit of John Maynard Keynes' General Theory [1936]. Macroeconomics"

nomics would then no longer suffer from the "ad hocery" of the neoclassical synthesis, which had overridden the emphasis in The General Theory on the role of psychological and sociological factors, such as cognitive bias, reciprocity, fairness, herding, and social status. My dream was to strengthen macroeconomic theory by incorporating assumptions honed to the observation of such behavior."(Akerlof [2002]: 411)

We can see now at the end of section 3 that logic and psychology provided a strong help to build Keynes's intellectual construction. History, political science and sociology might also have been investigated and would have reinforced the conclusion that Keynes's point of view is fundamentally interdisciplinary and excludes a closed view of economics. This conclusion is crucial. For us it provides the main foundations of the opposition between traditional and Keynes' economic approaches even if it started from the particular case of decision-making process.

(i) We indeed noted that "classical" and modern mainstream analysis indeed supposed that economic science is closed or self-contained, namely based on axiomatic "fundamentals" and this is true in general economic equilibrium (*GEE*) research program as well as in standard simultaneous game theory. Pareto and Schumpeter strongly contributed to popularize this view. To be more precise, for Schumpeter, Walras founded the most rigorous form of traditional economic analysis when he built his *GEE* model (see Arena [2005] and [2014]). Therefore, according to Schumpeter, the existence of a "causal relation" between "fundamentals" and Walrasian unknown quantities and prices establishes economics as a science in its own right. Thus, after Walras, economists could legitimately claim that economic analysis is a perfectly self-contained and consistent science that does not require any analytical or methodological support from other social sciences. This characterization of a self-contained economics can be applied to the *GEE* research program from Léon Walras to the end of the XXth century. It can also be applied to standard and simultaneous game theory *till the beginning of the XXIst century*. It only began to be contested later with the emergence of a new microeconomics based on dynamic game theory and of *BE*.

(ii) If we consider now Keynes's various interpretations we presented in part 1 of this paper, we can distinguish four groups. The first group includes the traditional reinterpretations which saw in Keynes's economic theory a pure macroeconomic analysis which could allow the construction of a Keynesian/Neo-classical synthesis but was methodologically analogous to traditional theory. The second group corresponds to models which tried to find microeconomic foundations for a macroeconomic representation explaining disequilibria through *ad hoc* rigidity (of prices, wages...) assumptions. The third group also accepts the notion of microeconomic foundations but maintains usual rationality assumptions and introduces asymmetric information. The fourth group includes all the Cambridge and Post-Keynesian economists and introduces various assumptions concerning money supply, expectations, marginal efficiency of capital and labour market. Maybe apart from the last group (see for instance, Arena, Dow and Klaes [2009]), psychology, history and sociology do not play a major role in these various approaches and as far as it is concerned, inter-disciplinarity occupies a rather limited methodological space.

The previous remarks and our paper confirm the methodological opposition between both our types of economic approaches. This opposition has still to be investigated to-day since the debates related to it are far to be ended. Keynes indeed never dedicated his writings to *strictly methodological* developments and to-day Keynes's ideas still more remain an inspiration in various fields and not a finished and complete construction.

4. Concluding remarks

There is a central issue which we did not consider in our paper. We indeed noted that – according to us – Keynes's theory could not be interpreted as the origin of pure *ad hoc* macroeconomics or as an approach of the rational micro- foundations of macroeconomics. This point of view is however intellectually costly since it deprives us from the possibility of using any optimizing form of rationality and consequently of a simple and convenient definition of individuals.

This is why we tried in both parts of our paper to find a new way of coping with the notion of interdisciplinary rationality. But which is the consequence of the introduction of this new conception of behaviour in order to understand what individuals are then becoming?

First, it is clear that this new form of behaviour cannot be a purely *formal* form, and therefore differs from the traditional conception of rationality. To clarify this remark what we mean is that it cannot be a non-human and purely logical rationality based on objective probabilities and able to be transformed in a second stage into a human one deducted or derived from the first one. Keynes rejected very early in his writings this possibility.

Secondly, a new way of defining individuals would be to define them as “irrational”. This potential solution cannot be held however. To understand this impossibility, let us take the example of a subjective and purely emotional form of rationality mentioned by Baddeley ([2017]:185) with the help of Keynes's writings: “*Fluctuations in the state of confidence and difficulties in judging the weight of probabilities leaves a gap for psychological influences, especially emotions, in Keynes's macroeconomic analysis. Emotions play an important role when concrete objective decisions are difficult to make. Keynes argues that, when a large number of alternative exist and none are obviously more rational than the other options: 'we fall back ...on motives of another kind, which are not rational in the sense of being concerned with the evaluation of consequences but are decided by habit, instinct, preference, desire [and] will' (GT, p. 294). For instance, alongside the objective determinants of consumption (including wages, income changes, windfall gains, discount rates and a government's fiscal stance) there are subjective emotional influences including 'Precaution, Pride, Avarice, Enjoyment, Generosity, Miscalculation, Ostentation, Extravagance, Shortsightedness... (GT, p. 108) [...] (However)[RA and EN] Keynes captures the impact of these influences via a series of 'thought experiments'.*”

Baddeley confirms what we already expected. Keynes's individuals cannot be irrational. Even in the case where this assumption seemed *a priori* possible, Keynes chooses to maintain his own conception of expectations assuming that their determinants are included among emotional motives and factors.

Thirdly it could also be possible to suppose that individuals do exist but that they do not play the leading role in the working of the economic system. Two versions of this view are conceivable. The first is *atomic individualism* according to which individuals are present but do not take really decisions; economic or social groups and commodities are the real determinants of individual behaviour and what we call our "individuality" is invariably shaped by our social relationships. Keynes discussed this form of individualism but finally abandoned it leaving however a large space to individuals.

Conversely, some commentators interpreted what they called Keynes's macroeconomics as a framework in which institutions and economic policy are predominant especially because they have permanently to contribute to a compensation of cognitive and economic weaknesses and deficiencies due to individuals; we could speak here of an *institutional individualism*.

Again, this view never was Keynes's one even if institutions played in a different way a major role in the economics of Keynes but finally it confirms what we tried to argue in our paper. Individuals are faced to uncertainty and develop a form of *inter-disciplinary* economics (to be still developed to-day) in which individuals are not income-constrained optimizers but *social* and *interactive* actors within firms, banks, economic policy and in real, monetary and financial markets.

References

- AKERLOF G. A. [2002], Behavioral Macroeconomics and Macroeconomic Behavior, *American Economic Review*, 92(3), 411-433.
- ALMEIDA F., CURADO M. [2019], The Role of Observation, Cognition, and Imagination in Keynes's Approach to Decision-Making, *Economia*, 20(1), 15-26.
- ARENA R. [2005], Walras, Schumpeter et la Naissance de la Science Économique Moderne, in: Leroux A., Livet P. (eds.) *Leçons de Philosophie Économique – Tome 1: Économie Politique et Philosophie Sociale*, Economica, Paris, 332-360.
- ARENA R., DOW S., KLAES M. [2009] (eds), *Open Economics: Economics in Relation to Other Disciplines*, Routledge Studies in the History of Economics, Abingdon, Routledge.
- ARENA R. [2014], The role of Walras in and for Schumpeter's Work: an Intellectual link revisited, in: *Economies et Sociétés: Trente Ans d'Histoire de la Pensée Économique*, PE, 51(11-12), 1981-2012.
- BADDELEY M. [2013], Herding, Social Influence and Expert Opinion, *Journal of Economic Methodology*, 20(1), 35-44.
- BADDELEY M. [2017], Keynes' Psychology and Behavioural Macroeconomics: Theory and Policy, *The Economic and Labour Relations Review*, 28(2), 177-196.
- BARNETT V. [2013], *John Maynard Keynes*, Routledge, London.
- BASILI M., ZAPPIA C. [2009], Keynes's 'Non-numerical' Probabilities and Non-additive Measures, *Journal of Economic Psychology*, 30(3), 419-430.
- BATEMAN B. [1987], Keynes's Changing Conception of Probability, *Economics and Philosophy* 3(1), 97-119.
- BRADY M. E., ARTHMAR R. [2012], Keynes, Boole and the Interval Approach to Probability, *History of Economic Ideas*, 20(3), 65-84.
- CARABELLI A. M. [1988], *On Keynes's Method*, St Martin's Press, New York.
- CARABELLI A. M. [1992], Organic Interdependence and Keynes's Choice of Units in the *General Theory*, in: Gerrard B., Hillard J. (eds.), *The Philosophy and Keynes's General Theory for Today Economics of J.M. Keynes*, Cheltenham UK and Northampton MA: Edward Elgar, 3-31.
- CARABELLI A. M. [1994], Keynes on Mensuration and Comparison, in: Vaghn K. (ed.), *Perspectives in the History of Economic Thought Volume X. Method, Competition, Conflict and Measurement in the Twentieth Century*, Cheltenham, UK and Northampton MA: Edward Elgar, 204-38.
- CARABELLI A. M. [1995], Uncertainty and Measurement in Keynes: Probability and organicness, in: Hillard J., Dow S. (eds.), *Keynes, Knowledge and Uncertainty*, Cheltenham UK and Northampton MA: Edward Elgar, 137-60.
- CARABELLI A. M. [2012], A New Methodological Approach to Economic Theory: What I Have Learnt From 30 Years of Research on Keynes, in: Jespersen J., Madsen M.O. (eds.), *Keynes's General Theory for Today*, Edward Elgar Publishing, 79-97.
- CARABELLI A. M., DE VECCHI N. [2001], Hayek and Keynes: From a Common Critique of Economic Method to Different Theories of Expectations, *Review of Political Economy*, 13(3), 269-285.

- CODDINGTON A. [1976], Keynesian Economics: The Search for First Principles, *Journal of Economic Literature*, 14(4), 1258-73.
- DAVIDSON P. [1980], Post Keynesian Economics: Solving the Crisis in Economic Theory, in: Kristol I., Bell D. (eds.), *The Crisis in Economic Theory*, Basic Books, New York, 151-73.
- DAVIDSON P. [1982-83], Rational Expectations: a Fallacious Foundation for Studying Crucial Decision-Making Processes, *Journal of Post Keynesian Economics*, 5(2), 182-98.
- DAVIDSON P. [1991], Is probability theory relevant for uncertainty? A Post Keynesian perspective, *Journal of Economic Perspectives*, 5(1), 129-43.
- DAVIDSON P. [2011], Behavioral Economists Should Make a Turn and Lean from Keynes and Post Keynesian Economics, *Journal of Post Keynesian Economics*, 33(2), 251-4.
- DAVIDSON P. [2016], Rejoinder to Rosser, O'Donnell, and Carrión Álvarez and Ehnts on their Criticisms of my Ergodic/nonergodic Formulation of Keynes's Concept of an Actuarial Certain Future vs. an Uncertain Future, *Journal of Post Keynesian Economics*, 39(3), 308-333.
- DAVIS J. B. [2009], *Keynes's Philosophical Development*. Cambridge University Press, Cambridge.
- DE CARVALHO F. J. [1988], Keynes on Probability, Uncertainty, and Decision Making, *Journal of Post Keynesian Economics*, 11(1), 66-81.
- DEQUECH D. [1997], Uncertainty in a Strong Sense, *Economic Issues*, 2(2), 21-43.
- DOSTALER G., MARIS B. [2009], *Capitalisme et Pulsion de Mort*, Albin Michel, Paris.
- EICHNER A., KREGEL J. A. [1975], An Essay in Post Keynesian Theory: a New Paradigm in Economics, *Journal of Economic Literature*, 13(4), 1293-312.
- FUNG M. V. [2006], Developments in Behavioural Finance and Experimental Economics and Post Keynesian Financial Theory, *Journal of Post Keynesian Economics*, 29(1), 19-39.
- FUNG M. V. [2010], Comments on 'Can Post Keynesians Make Better Use of Behavioural Economics?', *Journal of Post Keynesian Economics*, winter 2010-2011, 33(2), 235-249.
- FUNG M. V. [2011], The Potential Contributions of Behavioural Finance to Post Keynesian and Institutionalist Finance Theories, *Journal of Post Keynesian Economics*, summer, 33(4), 555-573.
- GERRARD B. [1994], Beyond Rational Expectations: A Constructive Interpretation of Keynes's Analysis of Behaviour Under Uncertainty, *Economic Journal*, 104(423), 327-337.
- GILLIES D. [2003], Probability and Uncertainty in Keynes's *General Theory*, in: Mizuhara S., Runde J. (eds.) *The Philosophy of Keynes's Economics: Probability, Uncertainty and Convention*, Londres, Routledge, 108-26.
- GOOD I. J. [1950], *Probability and the Weighing of Evidence*, London: Charles Griffn.
- KEYNES J. M., [1904], Ethics in Relation to Conduct, *Keynes Papers*, MSS, UA/19/2, King's College, Cambridge.
- KEYNES J. M. [1910], *8 Lectures on Company Finance and Stock Exchange*, Keynes Papers, King's College, Cambridge.

- KEYNES J. M. [1936], *Théorie Générale de l'Emploi, de l'Intérêt et de la Monnaie*, Traduction de l'Anglais par Jean De Largentaye, Paris, Payot, 1942.
- KEYNES J. M. [1972], [1931], Ramsey as a Philosopher, *Essays in Biography*, in *The Collected Writings of John Maynard Keynes Vol. X*, Macmillan, London.
- KEYNES J. M. [1973a], [1921], *Treatise on Probability*, in *The Collected Writings of John Maynard Keynes*, Vol. VIII, Mac Millan, London.
- KEYNES J. M. [1973b], [1936], *The General Theory of Employment, Interest and Money*, in *The Collected Writings of John Maynard Keynes*, Vol. VII, Mac Millan, London.
- KEYNES J. M. [1973c], [1937], The General Theory of Employment, *Quarterly Journal of Economics*, February 1937, in *The General Theory and After, Part 2: Defence and Development, The Collected Writings of John Maynard Keynes*, Vol. XIV, Mac Millan, London.
- KEYNES J. M. [1973c], [1938], Letter to Roy F. Harrod, 4 July 1938, in *The General Theory and After, Part 2: Defence and Development, The Collected Writings of John Maynard Keynes*, Vol. XIV, Mac Millan, London.
- KEYNES J. M. [1973d, 1934], *The General Theory and After, Part I: Preparation*, in *The Collected Writings of John Maynard Keynes*, Vol. XIII, Mac Millan, London.
- KEYNES J. M. [1979] [1937], Letter to H. Townshend: 11 April 1937, in *The Collected Writings of John Maynard Keynes*, Vol. XXIX, Mac Millan, London.
- KING J. [2010], Keynes and Psychology', *Economic Papers A Journal of Applied Economics and Policy*, March, 29(1): 1-12.
- KNIGHT F. H. [1921], *Risk, Uncertainty and Profit*, Houghton Mifflin Company, Boston.
- KOOPMAN B. O. [1940], The Axioms and Algebra of Intuitive Probability, *Annals of Mathematics*, 41, 269-292.
- KOUTSOBINAS T. [2004], The Formation of Conventional Expectations in Keynesian Fundamental Uncertainty, *International Journal of Social Economics*, 31 (11:12), 1108-19.
- KREGEL J. A. [1987], Rational Spirits and the Post Keynesian Macro-Theory of Microeconomics, *De Economist*, 135(4), 520-32.
- KREGEL J. A. [1997], Margins of Safety and Weight of the Argument in Generating Financial Fragility, *Journal of Economic Issues*, 31(2), 543-8.
- LAWSON T. [1985], Uncertainty and Economic Analysis, *Economic Journal*, 95(380), 909-927.
- LUCAS R. [1981], *Studies in Business Cycle Theory*, Basil Blackwell, Oxford.
- MARCHIONATTI R. [2010], J. M. Keynes, Thinker of Economic Complexity, *History of Economic Ideas*, 18(2), 115-146.
- MARSHALL A. [1890], *Principle of Economics*, Mac Millan, London.
- MINI P. V. [1994], *John Maynard Keynes, a Study in the Psychology of Original Work*, Mac Millan Press, London.
- MINSKY H. P. [1975], *John Maynard Keynes*, Columbia University Press, New-York.
- MINSKY H. P. [1986], *Stabilizing an Unstable Economy*, Yale University Press, New Haven.
- MOORE G. E. [1903], *Principia Ethica*, Cambridge University Press, Cambridge.
- MUCHLINSKI E. [1998], The Philosophy of John Maynard Keynes: a Reconsideration, *Cahiers d'Économie Politique*, 30-31, 227-253.

- NASICA E. [2010], Rational and Innovative Behaviours at the Core of Financial Crises: Banking in Minsky's Theory, in: Papadimitriou D., Wray L.R. (eds.), *The Elgar Companion to Hyman P. Minsky*, Northampton: Edward Elgar, 160-191.
- O'DONNELL R. [1989], *Keynes: Philosophy, Economics and Politics*, Macmillan, London.
- O'DONNELL R. [1990], An Overview of Probability, Expectations, Uncertainty and Rationality in Keynes's Conceptual Framework, *Review of Political Economy*, 2(3), 253-66.
- O'DONNELL R. [2014], A Critique of the Ergodic/nonergodic Hypothesis Approach to Uncertainty, *Journal of Post Keynesian Economics*, 37(2), 187-209.
- PECH W., MILAN M. [2009], Behavioral Economics and the Economics of Keynes, *The Journal of Socio-Economics*, 38(6), 891-902.
- RUNDE J. [1990], Keynesian Uncertainty and the Weight of Arguments, *Economics and Philosophy*, 6(2), 275-92.
- RUNDE J. [1994], Keynesian Uncertainty and Liquidity Preference, *Cambridge Journal of Economics*, 18(2), 129-144.
- RUNDE J., MIZUHARA S. (eds) [2003], *The Philosophy of Keynes' Economics*, London, Routledge.
- SAVAGE L. [1954], *The Foundations of Statistics*, John Wiley, New-York.
- SCHETTAKAT R. [2018], The Behavioral Economics of John Maynard Keynes, September, *Schumpeter discussion papers of business and economics*, University of Wuppertal, Germany.
- SCHUMPETER J. A. [1934], *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Cambridge (Mass.), Harvard University Press.
- SCHUMPETER J. A. [1939], *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist process*, 2 Vol. New York, McGraw-Hill.
- SHACKLE G. L. S. [1955], *Uncertainty in Economics*, Cambridge University Press, Cambridge.
- SHACKLE G. L. S. [1967], *the Years of High Theory*, Cambridge University Press, Cambridge.
- SHACKLE G. L. S. [1972], *Epistemics and economics*, Cambridge University Press, Cambridge.
- SHACKLE G. L. S. [1974], *Keynesian Kaleidics*, Edinburgh University Press, Edinburgh.
- SMITH C. A. B. [1961], Consistency in Statistical Inference, *Journal of the Royal Statistical Society*, 23(1), 1-25.
- TOWNSHEND H. [1979], [1937], Letter to J.M. Keynes: 7 April 1937, in *The Collected Writings of John Maynard Keynes*, Vol. XXIX, Mac Millan, London.
- VERCELLI A. [2010], Weight of Argument and Economic Decisions, in: Marzetti S., Scazzieri R. (eds.), *Fundamental Uncertainty, Rationality and Plausible Reasoning*, Basingstoke, Palgrave Macmillan.
- VERCELLI A. [2016], Microfoundations, Methodological Individualism and Alternative Economic Visions, *Review of Political Economy*, 28(1), 153-167.
- WALLISER B. [1985], *Anticipation, Équilibre et Rationalité Économique*, Calman-Lévy, Paris.
- WINSLOW E. G. [1986], Keynes and Freud: Psychoanalysis and Keynes' Account of the Animal Spirits of Capitalism, *Social Research: an International Quarterly*, 53(4), 549-578.

- ZAPPIA C. [2015], Keynes on Probability and Decision: Evidence from the Correspondence with Hugh Townshend, *History of Economic Ideas*, 23(2), 145-164.
- ZAPPIA C. [2016], Whither Keynesian Probability? Impolite Techniques for Decision-Making, *The European Journal of the History of Economic Thought*, 23(5), 835-862.