

## DID KEYNES' LOGICAL THEORY OF PROBABILITY HAVE IMPACT ON ECONOMIC THINKING?

*Review and comments to the paper by Bélyácz – Daubner<sup>1</sup>*

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### ABSTRACT

The authors published their paper in the previous issue of this journal under the title 'Logical probability, uncertainty, investment decisions' and with the subtitle in brackets 'Did Keynes' logical theory of probability have impact on economic thinking?'.<sup>1</sup>

Both the title and the subtitle of the paper indicate the authors' intention to find out if Keynes' theory of logical probability had an impact on economic thinking in general. Note that according to the *Abstract*, the authors of the paper also wanted to find out whether or not Keynes' theory of logical probability had an impact on his own economic thinking.<sup>3</sup> The authors review several theories and analyse their correlations as well as Keynes' impact on modern economics.

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*Keywords:* keynesian, macroeconomics, neo-keynesian, neoclassicism

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1 BÉLYÁ CZ, IVÁN – DAUBNER, KATALIN (2020): Logical Probability, Uncertainty, Investment Decisions. *Did Keynes's logical theory of probability have impact on economic thinking? Economy and Finance* 7(1), 2–46.

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3 British mathematician and economist JOHN MAYNARD KEYNES (1883–1946) was maybe the best known monetary representative of modern macroeconomy. In his main work, published in 1936, *The General Theory of Employment, Interest and Money*, GT he argued for the division of economics into two independent parts, which took place after his death. Their names today are macroeconomy and microeconomy. The economic approach he established is called Keynesianism. Keynes was also one of the founders of the system of logical probability.

## 1 COMMENTS ON THE FINDINGS OF THE PAPER WITH SHORT EXTRACTS

### 1.1 The Introduction

The authors' starting point is that despite four centuries of research and the acceptance of formalised axiomatic systems by many, there is no consensus regarding the economic connotations of probability. *Hacking* expressed his doubts writing in 1975 that none of the numerous interpretations emerging through the ages could settle the debate on what actually probability is.

First, the authors discuss the different approaches to probability in depth including the *classical, the frequency and the logical approach, the subjective interpretation, the subjectivist probabilities, the propensity interpretation* and all the theories and criticism of the above. They discuss the division of probability interpretations epistemologically and ontologically, into inductive and objective versions.

They advise that the foundation of Keynes' subsequent views were laid down in his *Treatise on Probability* (TP) published in 1921, in which he declared, "*There appear to be four alternatives:*

- 1) *Either in some cases there is no probability at all; or*
- 2) *probabilities do not all belong to a single set of magnitudes measurable in terms of a common unit; or*
- 3) *these measures always exist, but in many cases are, and must remain, unknown; or*
- 4) *probabilities do belong to such a set and their measures are capable of being determined by us, although we are not always able so to determine them in practice".*

The authors call attention that in his work *The General Theory of Employment, Interest and Money* (GT) published in 1936 Keynes broke away from the partial equilibrium analysis-based approach of classical economics. In the main his theory can be regarded as an aggregated general equilibrium framework centred on uncertainty. Keynes wrote *The General Theory of Employment* (GTE) published in 1937 with the purpose of summarising what the GT had to say and putting forward an even more convincing argument for its claims. In these two papers Keynes expresses his view that the performance of the economy as a whole is mainly determined by the volume of investment. He considered the quantity of investment to be the factor defining "the level of output and employment as a whole". In fact, the authors' starting point is the same, i.e. they intended in this way to outline the grounds for shifts in Keynesian thinking right at the beginning.

According to the study, the basis of Keynes' conceptual framework is the assumption of uncertainty. Keynes interprets certainty (rational belief) as something that does not only require complete confidence in the belief, but also the accuracy of the belief. In Keynes's case, this certainty equates to knowledge. The authors declare "*Keynes is not as sceptical and agnostic as he is assumed to be. Keynes distinguished between two types of knowledge: the kind of knowledge that can be directly obtained and that which can only be obtained indirectly. One is the directly obtainable part of rational belief and the other is what we can deduce through argument*".

One can agree with the authors' statement that Keynes committed himself to the broader logic of conclusiveness rather than simple logical deduction and numerical probabilities. According to the study, Lawson's opinion (1988) should be worth considering, who described Keynes' attitude towards this as follows: "*...throughout his total contributions he is explicit that ... a priori thought is considered always to be open to constant modification and correction through continual interaction with experiences of the real world*". No doubt is left that probability statements, not being regarded as relative frequency, should be contingent on the current evidence and knowledge, in line with Keynes' expectations, but that changes in them should also be regarded as natural.

## **1.2 Criticism of the classical probability concept**

This chapter deals with the evolution of the classical probability concept and its applicability in economics.

The authors agree that the main problem with studying the part played by *probability* is that there is no explicit and comprehensive definition of probability that could be applied universally to all branches of science. In their paper they emphasise that they do not deal with the axioms, postulations and paradigms of mathematical probability calculus, instead, they discuss the aspects of probability that are related to economic questions in general, and specifically to investment decisions. At the same time, they emphasise that based on the approach "*probability may be objective, subjective and logical by nature, and based on the method it may be classical probability, relative frequency and propensity interpretation.*"

The authors underline the importance of the classical approach, which means that the probability of an event, in a given random trial, is the ratio between the equal-chance outcomes related to a given event and the number of equal-probability outcomes. It was, in fact, *Laplace* (1812) who fully described this by deriving probability from general determinism, as the authors of the paper note.

The study reiterates that the great thinkers of probability articulated three essentially identical principles arguing that *probability* originates from the limitations

of human knowledge. According to the “law of sufficient reason” the symmetry of outcomes presupposes identical probability for each outcome. The authors refer to the “law of insufficient reason” and express agreement with the ideas of Laplace and Bernoulli, who state “if we do not know which outcome is more likely, then we assign the same probability to each one” (Laplace, 1812; Bernoulli, 1713). The “principle of indifference” states that equal probabilities must be assigned to each of several arguments if there is an absence of positive ground for assigning unequal ones”. In this regard, they present Keynes’ definition (1921): “*The Principle of Indifference asserts that if there is no known reason for predicating of our subject one rather than another of several alternatives, then relatively to such knowledge the assertions of each of these alternatives have an equal probability*”.

Following the analysis of the knowledge used and the correlations revealed, the authors jointly state that the classical concept of probability emerged as a formalised theory in the second half of the 19<sup>th</sup> century as the *theory of relative frequency*. In their opinion, its main proponent was *John Venn* (1888/1962), who regarded *the sequence* and *the limit* as the cornerstones of his theory. Based on previous analysis of the literature, we agree with that consistent statement. It should be noted however, that Venn created the framework on which the frequency interpretation could be based. The authors considered important to underline Venn’s definition for the concept of sequence. They call attention – correctly – that sequence is a chain of events, their linkage.

An important observation of the study says, „by the end of the 19<sup>th</sup> century it had become clear that the classical interpretation of probability does not guarantee the quantification of probability, and nor is it suitable for the probability rating of individual events and decisions in the absence of a series of events.” *That is why it stimulated intellectual exploration and the development of new probability interpretations*<sup>4</sup>.

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4 WEINTRAUB (1975) concisely expressed the situation prevailing at the turn of the 19<sup>th</sup> and 20<sup>th</sup> centuries as follows: “At that time the only explicit theory which delineated the meaning of the proposition ‘the probability that  $x$  is  $y$  is  $p$ ’ was that of Venn, which provided a relative frequency interpretation of probability statements. Such a theory asserted that the meaning of ‘the probability that  $x$  is  $y$  is  $p$ ’ was that a large number of cases had been examined in which  $x$  was  $y$  and  $x$  was not  $y$ , and  $p$  was the proportion of the former in the total number of cases” (op. cit. 532).

### 1.3 The Keynesian logical theory of probability

In this chapter the authors present the foundations of Keynes' logical theory of probability and the difficulties of its implementation in practice.

They state that „*Keynes in his 1921 work based on logic and philosophy (TP) elaborated a concept of probability that placed the roles of uncertainty, expectations and behaviour in economic decision making on a radically new footing.*”

The authors point out that Keynes' 1937 work (GTE) included an explanation for his departure from the fundamental ideas of classical economics, by saying „...*I sum up, therefore, the main grounds of my departure [from the traditional theory] as follows: The orthodox theory assumes that we have a knowledge of the future of a kind quite different from that which we actually possess. This false rationalism follows the lines of the Benthamite calculus. The hypothesis of a calculable future leads to a wrong interpretation of the principles of behaviour which the need for action compels us to adopt, and to an underestimation of the concealed factors of utter doubt, precariousness, hope and fear.*”

In the study they interpret Keynes' statement claiming that the classical (traditional) theory encompasses situations that are handled with the tools of probability in keeping with the application of risk. The authors underline the emphasis of the classical theory and point out its core ideas, which assumes that a person can maximise the expected pay-out despite the fact that the likely values cannot be reliably calculated.

*They point out that Keynes „did not believe that entrepreneurs make a list of all the possible future outcomes, assign a probability to every item on the list, and then calculate the expected value. Keynes regarded the probability theory, like economics, to be a part of logic, and and at the beginning of his treatise he made it clear that his theory – in essence – was objective. For him, probability is the degree of rational belief and not simply the degree of belief.”*

It is also declared that in his 1921 work Keynes (TP) rejected the theory of relative frequency because „probability is not related to the balance of favourable and unfavourable evidence, but to the balance of the absolute quantity of relevant knowledge and that of relevant ignorance, in such a way that the discovery of new evidence increases the weight of the argument.” In their analysis, the authors discuss O'Donnell's important realisation, i.e. the TP was more logical than epistemic in character. Keynes' TP is concerned with the path leading from the premises to the conclusion, that is conceivable but not certain.

It is emphasised that one of the most disputed aspects of Keynes' logical theory of probability is its objective or subjective nature. Rosser (2001) asserts that an important aspect of Keynes's view on probability is that he himself considered

it to be essentially subjective; that is, something that can be constructed on the basis of internal logic rather than from mathematical calculations of the distribution of external observations. *Hársing* (1965) provides a convincing explanation to resolve this dilemma. The authors point out that in his analysis Keynes starts out from the fact that we can differentiate between objective phenomena that exist independently of human consciousness, which are customarily referred to as events in probability theory, and the subjective mirror-images of these that are created in our consciousness.

It should be noted that the application of the mathematical probability calculus is based on the assumption that probabilities are measurable. In his core work, Keynes (1921) denied that all probabilities are numerically measurable or suitable for positioning on a standardised scale of sizes.

*Kay* (2012) supports *Skidelsky's* opinion, who believed that understanding Keynes's approach to probability was the key to understanding the rest of his work. Keynes believed in the financial and business environment to be characterised by "radical uncertainty". The only credible answer to the question of "what will interest rates be in twenty years' time" is "we simply don't know"<sup>5</sup>.

*Hársing* (1971) emphatically points out that Keynes does not limit probability calculation to the analysis of games of chance and insurance transactions, and even if it means partially relinquishing the quantitative aspect, he attempts to retain the original broadness of the concept of probability. (It should be noted that probability calculus, as a mathematical theory, emerged as a result of the work of B Pascal and Jakob Bernoulli in relation to the analysis of the outcomes of games of chance.)

The authors state that it is generally accepted that Keynes's concept of logical probability is "of a comparative nature". They believe "this necessarily follows from the effort to elaborate a logical theory of probability that was more exact than before, without narrowing the definition of probability". Several analysts have emphasised that Keynes resisted excluding, from the theory, probabilities that did not lend themselves to quantitative evaluation.

The authors' findings are correct inasmuch as „*faced with the fact that after his TP of 1921, Keynes neither published any new work on logical probability nor took part in the continued development of the logical probability school of thought – initiated*

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5 *KAY* (2012) believes that this was forward-looking and prescient commentary on the part of Keynes. Twenty years before publication of the TP we find ourselves in 1941, when Great Britain, at a critical stage of the Second World War, is engaged in a life-and-death struggle for survival. Keynes saw the future more clearly than most, but when it came to what specific events would take place, he simply did not know. Like everyone else.

*by him – we have to agree with Hársing’s (1971) conclusion that Keynes regarded the creation of his preferred version of logical probability as being important as a means of underpinning the results of his specialist (economics) research.”*

To sum up, it can be said that Keynes pitted the complete future knowledge of classical economics against uncertainty.

#### **1.4 The role of uncertainty in the Keynesian conceptual framework**

In this chapter the authors seek to answer the question how close the relationship between Keynes’ theory of probability and that of economics is and whether one can demonstrate conceptual continuity between TP (1921) and GT (1936). To answer it, they analysed the role of uncertainty in the Keynesian concept in detail.

Uncertainty is a central category in Keynes’s (1921) seminal work on probability, in which he describes this concept and phenomenon as multidimensional. Uncertainty features in this work with two independent definitions, with the two meanings deriving from the concepts of probability and weight.

The authors have revealed that the thinkers of the literature of probability have commented on the question of uncertainty in Keynes’ concept differently and from different approaches. According to one opinion, uncertainty – in this sense – originates from a partial lack of relevant knowledge (O’Donnell). Another (Rosser, 2001) says Keynes’ conception of uncertainty developed paradoxically over time and one reason for this was that Keynes presented several different arguments relating to uncertainty, encapsulating certain shifts in his views, increasingly emphasising that the chief characteristic of uncertainty is its unquantifiable nature.

The authors also point out that hogy Keynes’ 1937 article (GTE) gives the most complete explanation of uncertainty as he perceived it. They underline that Keynes deals with *four* versions of uncertainty in that article which means that he himself differentiated between the various degrees of uncertainty and did not consider fundamental uncertainty to be the only variant. The *first* group consists of events that have unknown outcomes, and an *ex ante* probability rate (or distribution). These are the sources of “probability knowledge”. A paradigmatic example of this is gambling in a casino. For Keynes, the source of the probability rate is compatible with the frequency approach, as well as with the objective interpretation of probability.

The *second* version – unlike the previous one – means uncertain events where there is no “scientific basis” whatsoever for the probability rate. These are events that are beyond scientific knowledge, regarding which only unsubstantiated esti-

mates can be made. According to *Knight* (1921), this is always the case when dealing with decisions made under unique circumstances.

As the *third* group, Keynes concedes that there are events which lie between the two extremes; as an example, he puts forward events that have no fixed ex ante probability rate, but are subjected to a credibly informed scientific analysis with a variable degree of certainty. The *fourth* is a version that is applied for practical reasons when uncertain events are treated as cases of probable knowledge although, from a theoretical perspective, such an act cannot be proven (cf. *Backhouse-Bateman*, 2006).

In the authors' interpretation, a comparison of the three seminal works gives an example of the changing substance of Keynesian uncertainty. In his GT of 1936 Keynes discusses "low weight" uncertainty, in his GTE of 1937 of "irreducible uncertainty" and in his 1938 correspondence with Townshend of "unrankable uncertainty". The first concept, "low weight uncertainty" appeared in Keynes's (1936) work. By "very uncertain" Keynes does not mean "very improbable" (Keynes, 1936).

The authors state that having such a wide variety of definitions of uncertainty, *Koppl* (1991) justifiably concludes that it is difficult to make a credible judgement based on uncertainty, especially given fundamental (radical) uncertainty, which Keynes emphasised in his (1921) and (1937) works in keeping with the weight of the argument. When knowledge is "uncertain", people are not capable of estimating probability, or at least not credibly; and they cannot claim to have more knowledge about the future. When knowledge is "uncertain", it is not possible to obtain a good Benthamite calculation of future value, whether in the moral, hedonic or economic sense. If the uncertainty is sufficiently large, then we simply do not know (Keynes, 1937). When that variant of uncertainty is present, the rational basis of action significantly weakens. We need the "animal spirits" to hold economic actors back from freezing their operations.

Most interpretations of uncertainty are epistemic, a good example of this – the authors advise – is *Davidson's* (1982) opinion. According to him, there are many situations, in which we are faced with "true" uncertainty regarding the future consequences of today's choices. In such cases, the decision-makers see that neither today's expenditure on the analysis of past data nor the present market indicators can be expected to offer reliable statistical or intuitive assistance in foretelling the future.

Recent decades have seen a growing recognition that uncertainty also has certain ontological aspects..

Further, the authors discuss *Dunn's* opinion (2000), which says that „*individuals are the builders of the future. In an uncertain world, the future – prior to its*



*formation – cannot be known, regardless of the calculation abilities attributed to individuals. It is not possible to know, ex ante, how any story will develop, and it matters not how much information and computing capacity a decision-maker has, the future can never be predicted ex ante with certainty (of probability)*”.

The authors lay special emphasis on the expectations the decisions rest on. These „expectations” are also dependent on imagination and intelligence, and on the narratives by which they are communicated; and they encapsulate feelings and emotions. In the study reference is made to *Bronk’s* opinion (2009), according to whom imagination and creativity are not merely the main causes of ontological uncertainty, they are also important tools for describing uncertainty... The future has no precise vision, since this will be determined subsequently with innovations that have not yet been discovered and with decisions that have not yet been made, as well as the opportunities in this regard; market valuations only reflect our best views, the preferred narratives and the fleeting attitudes of optimism and pessimism.

### **1.5 Animal spirits, expectations, investment decisions**

This chapter is an analysis of the consequences of uncertainty by discussing the „animal spirits”, the role of expectations and the investment decisions made under uncertain conditions.

The authors stress that *animal spirits* are a key category in Keynes’s (1936) seminal work on economics. According to Koppl (1991), animal spirits come into the frame as a cause of action on the one hand, and as a subsequent source of instability on the other. Keynes believes that most of our actions cannot derive from “a mathematical expectation, whether moral or hedonistic or economic”. He felt that “most, probably, of our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits” (Keynes, 1936). He defined *animal spirits* as “a spontaneous urge to action rather than inaction”.

Although Keynes saw the main thrust of the individual’s behaviour as an intention to maintain a rational economic face, he was also aware of the limitations on the attainability of such.

The authors refer to Keynes’ statement, which says that lack of information and the general uncertainty of the future prevent entrepreneurs from forming scientific or rational expectations; but if they need to act, they substitute this with conventional expectations which then determine their investment decisions. However, precisely because this expectation is largely conventional, it is vulnerable to waves of optimism or pessimism, and the general state is the famous animal

spirits (Keynes, 1936). The authors of the paper emphasise that Keynes also warns that the actions inducted by the animal spirits are fundamentally *irrational*. He believed that rational action and probability are inseparable phenomena. Keynes took the view that rational actions must be based on rational belief. When people revert to the animal spirits, they are not acting on the basis of beliefs that are considered to be rational. Therefore, their actions are not rational.

The authors underline that based on the foregoing, Koppl (1991) justifiably asks whether we need to take animal spirits seriously in economics. If we do, then is this not abandonment of an economic theory that is based on rationality? There is some evidence to suggest that “irrationalities” matter from time to time. Investor behaviour is sometimes justifiably labelled as “irrational”, because it can and does influence market processes. Koppl emphasises that there is no proof that people are irrational by nature. Rather, the signs show that it may be useful to take the animal spirits seriously, seeking those economic conditions under which the impulsive side of human nature counts, and those conditions under which it does not.

*According to Keynes, „the lack of information, and general uncertainty regarding the future, make it impossible for the decision-makers to form rational expectations, and this fact is pivotal with respect to their investment decisions. On this basis, Keynes does not conclude that every single actor forms his or her individual expectations that differ from those of all the other actors.*

Rosser (2001) views the Keynesian perception of uncertainty as a fundamental and unquantifiable phenomenon to be the basis for why the “bird on the wing” of real capital investment is directed not by long-term rational expectations, which would not even be possible, but is driven by the essentially subjective and ultimately “irrational” animal spirits, a spontaneous urge to action in the face of uncertainty. Hodgson (1985) confirms that irrational decision-making stems not from human nature, but from the circumstances surrounding the decision and action.

## 1.6 Role of expectations

The authors emphasise that Keynes makes a sharp distinction between short-term and long-term expectations. From these definitions, Keynes concluded that a company’s daily output depends on its short-term expectations, whereas its investment in new capital is a function of long-term expectations. Short term expectations greatly differ from long term expectations that entrepreneurs hope to achieve in some form of future profit. *Butos-Koppl* (1995) also analysed that correlation several times.

Keynes's theory of long-term expectations is based on his rationalism, and states that there is very little correspondence between expectations and the economic events. According to Butos–Koppl (1995), Keynes believed that economic expectations are subjective. However, the subjectivity of the expectations has more pronounced consequences in the case of long-term expectations than in the case of short-term expectations. Keynes (1936) in his core work on economics – in relation to long term expectations – discussed the future knowledge one would need to make the right decisions to support/boost capital projects. The paper calls attention to the correlation also emphasised by Keynes that, since a certain knowledge of the future cannot be attained, the decisions on capital projects, due to their nature, must be founded on the belief of cognition, which is in fact flimsy.

While short-term expectations are closely associated with the realised values, long-term expectations are not formed by a rational calculation, because they do not “rest on an adequate or secure foundation” (Keynes, 1937). All this leads us to conclude – the authors advise – that, in his view, long-term expectations cannot establish a systematic relationship with fundamental economic reality. Butos–Koppl (1995) perceptively concludes that, for Keynes, expectations regarding the future are states of belief.

*Coddington* (1982) believes that Keynes, in the context of the GT, presents uncertainty as an inherent part of investment decisions. This is the reason for Keynes's assertion that the foundation of knowledge for investments in the private sector is flimsy.

### **1.7 Investment decisions**

They are based on beliefs regarding future circumstances which, however, have to be based on the conditions of the present and past. Accordingly, investment behaviour may show capricious fluctuations either as the present conditions change unpredictably, leading to irregular fluctuation with regard to anticipated future conditions, or through changes in the beliefs forming the basis for the decisions, without any corresponding changes in the actual conditions. Of these two scenarios, it is the second that leads to autonomous volatility in the aggregated expenditure arising from investment decisions.

In keeping with this, *Coddington* (1982) maintains that if changes in private investment are rooted in the spontaneous and capricious functioning of the human mind, then there is a solution to Keynes's problem: such a cataloguing would provide the reason why this type of expenses fluctuates autonomously instead of responding to changes in objective circumstances. This is the way in which subjectivist ideas show themselves in Keynes's GT.

The authors deem it important to emphasise that, from the perspective of the Keynesian argument, it is not really the fact of uncertainty that is important, but rather how individuals are likely to react to the fact of the uncertainty. Accordingly, if investment decisions are shrouded in great uncertainty, manufacturers respond to this for as long as possible by making the same investment decisions during this period as they did in the previous one (because the results of the previous decisions are what the decision-makers know something about).

In line with the correlations revealed so far, the authors are in agreement with *Weintraub's* (1975) conclusion, that Keynes made a breakthrough in economics with his GT, specifically by making the relationship between uncertainty and investment explicit; and the theoretical core of this relationship was already present in the TP. Another aspect of this theoretical innovation was that Keynes moved beyond the games of chance and applied the language of probability to real decision-making situations. When evaluating alternative courses of action, individuals are driven by their views regarding the most probable outcome. The outcomes are manifest in the future; but they cannot be observed in the present.

The authors specifically underline that Keynes treated as fact the phenomena whereby 1) capital assets are long-lasting, 2) the desire to hoard money reflects the degree of our mistrust of the future, and 3) production needs time. These are all facts associated with a world in which time is of importance. The authors here reiterate, *“In the course of our previous reasoning it became clear that time and uncertainty are intertwined; the former inevitably attracts the latter”*.

Weintraub concludes that Keynes's system was dynamic in the traditional sense that it includes time as a material factor; thus, if investments are volatile due to uncertainty, there is no level of output or employment that can always be maintained. That is why Weintraub calls uncertainty an equilibrium phenomenon and can declare that Keynes was concerned with equilibrium problems. The animal spirits urge people to socially useful action driving investment.

Keynes believed the emergence of the Stock Exchange brought about a change. He wrote, “with the separation between ownership and management which prevails to-day and with the development of organised investment markets, a new factor of great importance has entered in, which sometimes facilitates investment but sometimes adds greatly to the instability of the system”. The new factor was speculation.

Although long-term expectations remain constant for a long time, they are nevertheless exposed to sudden and violent changes that may at times be caused by (sometimes irrational) speculation, although they can also be triggered by psychological changes. Keynes – as the authors have shown above – presents his own theory in the form of “animal spirits”. He claims that these are the forces behind

capital investments: “a spontaneous urge to action rather than inaction, and not ... the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities”.

### **1.8 Continuity or discontinuity in the role of probability in the Keynesian conceptual framework**

In this chapter the authors focus attention on discussing whether continuity or discontinuity prevailed in the Keynesian conceptual framework over time.

The authors reiterate in the paper that sharp differences of opinion have emerged for decades as to how Keynes' GT is related to the theoretical concept of his main work on probability TP. *Gillies* (1988) believes that at first consideration the link may be weak, since Keynes identified probability with the degree of rational belief in his TP.

The authors write that following Keynes' TP in 1921 there were sharp differences of opinion as to „there was continuity or a break of continuity”. On one side, there was the opinion that Keynes – mainly influenced by *Ramsey's* criticism – made a shift from logical probability to a subjective probability approach (*Bateman*, 1987). On the other side the prevailing opinion was that Keynes did not adapt any of the alternative methods of probability at variance from logical probability but that he continued his work under the original framework conditions of the TP. That view is represented most decidedly by O'Donnell (1990).

There is a marked difference between Keynes' (1921) and Ramsey's (1931) concept of probability, which has been influencing the debate on the topic to date. Ramsey was the first to describe the applicability of a subjective feeling as a means of interpretation. He looked upon this approach as being complementary to the frequency interpretation of probability, which was an established theory at that time. Ramsey emphasised the measurability of the probability relationship. *He believed it was possible to arrive at probability values with a behavioural experiment; that is, he viewed reliance on the betting process as an aid for determining belief.*

The main thrust of Ramsey's criticism was that the version of the probability relation discussed by Keynes simply does not exist, and Ramsey's own procedure (betting) makes it much easier to find the “degrees of belief” held by people.

The authors also state – on the basis of Keynes' response to Ramsey's criticism (1933) – that Keynes was willing to acknowledge Ramsey's opinion on several points; it is clear at the same time the two of them did not agree in everything. Speaking on Keynes' changing views of probability, *Bateman* (1987) comments Keynes adopted a subjective interpretation of probability.

As regards the question of continuity or discontinuity, the authors regard O'Donnell's view on this as definitive. He made two assertions: firstly, *Keynes's thinking continued to be based on the framework assumptions of the TP*; secondly, *there was an internal shift within the constraints of these assumptions after 1931*, whereby the importance of the indeterminate domain and the weight of weak rationality increased, while the significance of the determinate domain and the strong rationality decreased.

Gillies (1988) also poses the question of whether Keynes's view on probability changed over the years. He concludes that Ramsey's criticism of Keynes's views moved Keynes into an intermediate position between his original logical interpretation of probability and Ramsey's subjective probability theory. Gillies defines Keynes's new theoretical position as constructing a so-called *intersubjective probability theory*, making use of Keynes' views on the long-term expectations of entrepreneurs.

Based on the foregoing, we can state that Keynes was closer to the intersubjective epistemic theory than the subjective epistemic theory championed by Ramsey. Lawson (1985) rightfully concludes that intersubjective probability was closer to Keynes's earlier thinking, and that intersubjective probability occupies an intermediate position between rational belief (early Keynesian thinking) and subjective belief (Ramsey).

Gillies (1998) also points out that Keynes still did not capitulate to Ramsey, and he had doubts as to whether Ramsey provided a satisfactory explanation for the differentiation between the degrees of belief and the degrees of rational belief.

Instead, the authors, moving beyond the dichotomy of continuity versus discontinuity, examine the evolutionary process in which items that were present in the TP, but later evolved in Keynes's subsequent works, were adapted specifically for economics; namely, the applicability of the atomic hypothesis in the moral; that is, the social sciences.

*Hamouda-Smithin* (1988) points out that the above quotes contain no reference to economic or social sciences. In other parts of the TP, Keynes expresses the opinion that a clear distinction must be made between the natural sciences and the moral or social sciences; and while the atomic hypothesis may have a role in the former at any time, it is categorically inappropriate in the latter.

Towards the end of the 1930s, Keynes returned to the atomic-organic dilemma that resulted from the process of change that occurred in Keynes's conception of uncertainty between the mid-1920s and the end of the 1930s. During this period, Keynes's views on uncertainty were "radicalised"; the role of indeterminateness and the fundamental grew.

Based on the above quotations by the authors, Keynes clearly puts forward the view that the atomic hypothesis does not apply to the world of social relations. The elements of this world do not function as “legal” atoms, striving to exert their own independent effect under all circumstances, but yield willingly to various laws in all the alternative configurations of the system. On this basis, Keynes’s view on uncertainty can only be understood in relation to his vision of the social process.

### 1.9 Competing interpretations of probability in the twentieth century

The authors present the interpretations of probability embodied, on the one hand, in a newly worded version of the theory of relative frequency and, on the other hand, emerging through the development of the theory of logical probability external to a paradigm of economics.

In the authors’ opinion, the *classical probability theory* – from the late 19<sup>th</sup> century – came in for criticism due to the non-fulfilment of the principle of indifference and the principle of additivity, and the narrow scope for application of the theory. In fact, the narrow scope of the practical applicability of the theory limited its practical effects. They state that the most forceful challenge to the classical interpretation of probability came from Keynes’s seminal work on probability, laying the foundations for the system of logical probability.

Of the theories presented in the study, the following are to be underlined – the authors of the study also refer to them – as they have laid the foundation for their ideas.

Paradoxically, the challenging view that had the greatest impact was the “relative frequency” interpretation of probability put forward by *Richard von Mises* (1928) and *Reichenbach* (1961). In this theory, probabilities are associated not with individual results but with event types, and the theory itself takes an objective approach.

The basis of Richard von Mises’s probability theory is the concept of the *collective*. The rational concept of probability, in contrast to probability as used in everyday conversation, only receives a precise meaning if the collective to which it is applied is precisely defined in every case. The collective essentially consists of a series of observations that continue for an indefinite period. Every observation ends with the recording of a certain property. The relative frequency with which a specified property occurs has a limiting value in the series of observations. This interpretation has been compared with several authors’ opinion and works (*Hauwe*, 2011; *Hársing*, 1965; *Reichenbach*, 1961; and *Carnap*, 1950).

According to Hauwe (2011), Richard von Mises regarded the frequency approach to probability theory as a science of the same order as geometry or theoretical mechanics, because he believed that probability should be based on facts and not on a lack of them. The frequency theory links probability with the real world through the observed objective facts (or data), with special regard to the recurring facts.

According to Hársing (1965), Richard von Mises views relative frequency (statistical probability) as the exclusive form of probability. He defines probability as the limiting value of relative frequency obtained through the infinite repetition of a trial. He excludes the problem of moral decisions from the field of probability. In his opinion, the concept of probability is only applicable in the following three areas: games of chance, insurance transactions and mechanical and physical phenomena. The most importance circumstance is that Richard von Mises rejects the concept of logical probability on the basis that it is subjective in nature (Richard von Mises, 1928).

In his critique, Hauwe (2011) also mentions that probability in economics is not a manifestation of physical entities as Richard von Mises supposes when constructing his theory. The empirical underpinnings of probability are missing in the economic sense, for example with respect to objective frequency probability. The main flaw in this theory – the authors believe – is that it is too narrow, as probability is used in many important situations; but among these there are none in which the empirical collective can be defined in an economic context. The definition is too narrow for application in economics. They also identify mismatches between the theories of Richard von Mises and Keynes. For Richard von Mises, probability is part of empirical science; for Keynes, on the other hand, it is an extension of deductive logic. Richard von Mises defines probability as frequency with limiting values, and Keynes as a degree of rational belief. For Richard von Mises the probability axioms are derivable from two empirical laws by abstraction, while for Keynes they can be obtained through direct logical intuition.

The authors present a combined assessment of Hársing's (1965) evaluation of Richard von Mises's theory, which confirms the authors' supposition that this theory – in essence – is a redefinition of the 19<sup>th</sup>-century frequentist conception of probability. According to Richard von Mises, probability calculus is the theory of recurring cases of certain pseudo-random or random events or series of events, like the rolling of dice. These series are defined by two axiomatic conditions as a "pseudorandom" or random series: one of these is the convergence axiom (or boundary axiom), and the other is the axiom of randomness.

The authors have come to the conclusion that the two axioms used by Richard von Mises to define the "collective" have come in for strong criticism, which Hársing believes is not entirely unjustified. The linking of the convergence axiom and the randomness axiom, in particular, were criticised on the basis that it is not permis-



sible to apply the concept of the mathematical threshold value or convergence to a series which – by definition (viz. due to the randomness axiom) – cannot be subordinated to any kind of rule.

Attention is called to the fact that Reichenbach (1961) only recognises statistical probability, which – in his conception – is the limiting value of the relative frequency of random events. Accordingly, he believes that one-off events have no probability. Despite the fact that he ultimately only recognises statistical probability, Reichenbach also discusses logical probability. He believes, however, that logical probability is secondary in nature and can be traced back to statistical probability. Reichenbach regards the statistical approach of Richard von Mises to be the only possible interpretation. Thus, ultimately, Reichenbach's logical probability is nothing other than the logical interpretation of Richard von Mises's approach: the logic of statement sequences.

According to the authors (Bélyácz–Daubner, 2020), it should be noted with respect to the interpretation of the above that, following the publication of the TP, Keynes did not concern himself at all with the theoretical problems of probability; nevertheless, the issue of probability did reappear – albeit indirectly – in the GT, in connection with the formation of expectations. It should also be noted that Keynes did not participate in the scholarly efforts that came after the breakthrough in logical probability that he initiated. The following extracts from the authors of the paper should be underlined:

*„According to Carnap (1950) there is not one, but two concepts of probability; one is empirical, the other logical in nature, and both are objective. He considered the logical interpretation of probability to be one of several possible definitions rather than the only permissible one. In Carnap's view, one of the probability concepts is “probability 1”, which describes the relationship between statements (specifically the degree by which a statement logically strengthens other statements); the other concept is “probability 2”, which relates to the relationship between classes of events.*

*Amsterdamski (1965) highlights that, for Carnap, probability is the degree of confirmation of statements, while for Jeffrey (1939, 1954) it is the degree of rational belief. According to Amsterdamski, Carnap considers “degrees of rational belief” to be a bad term, because in Carnap's view the substance of Keynes's and Jeffrey's theory is that probability is nothing other than the degree by which a statement reinforces other statements; in other words, we are talking about logical probability.*

*Neither Jeffreys nor Keynes recognise the existence of the two probability concepts, so as far as they are concerned the probability statements were never about what kind of events are probable; they only ever talk about which statements receive the most robust confirmation from the information available to the subject. Carnap identifies the concept of rational belief – from Keynes's and Jeffrey's theory – with*

*the principle of his “degree of confirmation” and identifies the whole conception with logical interpretation.*

*Carnap defines the degree of confirmation in a semantic system. In this, a numerical value is assignable to every statement. If we know, for example, the numerical value assigned to statements  $k$  and  $a$ , the  $\underline{P}(a/k)$  value can be defined; that is, the extent to which  $k$  confirms  $a$  (Carnap–Stegmüller, 1954).*

*Pólya (1949) applies the premises of abstract probability calculus in a comparative sense, for investigation of so-called plausible conclusions. Pólya – like Carnap – recognises the legitimacy of the two interpretations of probability, but just like Keynes he regards logical probability as the degree of rational belief. He, however, categorically rejects the quantitative interpretability of logical probability.*

*Gillies (1988) takes propensity theory to be any approach that assumes objective probability but is not a relative frequency-based interpretation. Popper’s (1934) aim in creating propensity theory was to also be capable of assigning an objective probability to singular events<sup>6</sup>. Gillies criticises this view that objective probability can also be attributed to singular events; if we can find a narrowest reference class through which the probability of the singular event can be determined as the relative frequency of similar types of event in the given class.”*

### **1.10 The impact of probability theory on Keynes’ economic thinking**

In this chapter the authors reiterate their opinion that „in itself, the fact that in the analysis of long-term expectations set out in the GT we were able to refer, on several strands of enquiry, to the Keynes’s probability concepts and arguments found in his TP, shows that these probability labels could have been the roots of his ideas relating to expectations”.

The authors agree that the premise that Keynes’s thoughts on probability served as the basis for his theory of economic expectations is an accepted proposition among post-Keynesian thinkers. They support their opinion in the paper with quotes mainly from the works of O’Donnell, Skidelsky, Brady and Ramsey. The following extracts relating to Keynes are worth special attention.

They underline the reasoning of O’Donnell (1990), that Keynes’s (1921) TP is the appropriate starting point for understanding how the GT addresses uncertainty, expectations and behaviour. O’Donnell believes that we cannot find a precise par-

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<sup>6</sup> HÁRSING (1971a) believes that the physical motivation for this effort was quantum mechanics. POPPER (1997) – in his early theory – takes a set of initial generating conditions and regards them as having a certain tendency – a propensity – to “generate” the observed frequency.

allel; what we do find, however, is an intermediate parallelism: one factor is the transition from the philosophical to the economic plane, while the other is the shift towards non-determinedness within the constraints of Keynesian philosophy. O'Donnell also emphasises that Keynes (1921), in his work on probability, regarded it as a fundamental principle that philosophy and methodology perform a controlling function in economic argument. They call attention that it is in sharp contrast to the dominant role of expectations; probabilities have a subordinated role in the GT. Expectations rather than probabilities are the general concept of behaviour. Keynes' GT is primarily supported by induction and his inductive approach consists of two parts: the first is the projection of knowledge into the future; the second is a modification of the extrapolation in line with specific anticipated expectations. O'Donnell believes the second component is the really important one, since Keynes *recognised that extrapolation demanded by rational behaviour must be changed if there are grounds for believing that the future will differ from the past.*

The authors pay special attention to Keynes' comment to the effect that *probabilities must be made contingent on current uncertainties and knowledge, without regarding probabilities as relative frequency, since this will change after it has emerged.* Moreover, Keynes's focus on the fundamentally qualitative nature of reality suggests that both informal argument and intuitive judgement are necessary for economic reasoning.

They make it clear that the concept of rational belief has a key role in Keynes's works on probability and economics. He saw *two* paths to the attainment of rational belief regarding future prospects if perfect knowledge was not available. The *first* is based on the formation of probability, which can be arrived at either through uncertain information or a "doubtful argument". (1921) In the *second* case, it is impossible to define rational belief. In this event, actions are determined by the animal spirits. These are precisely the two types of uncertainty that classical theory rules out with the assumption that individuals have full or certain knowledge of what Keynes calls the "primary proposition" that a person sets out to validate.

The authors state that until the middle of the 20<sup>th</sup> century, the thinkers of economics concerned with uncertainty, risk and probability had deliberately embraced complexity, and used probability to represent it. The peak of this thought process was Keynes's TP of 1921, GT of 1936 and GTE of 1937; in these, probability and uncertainty appear as qualitative properties of decision-making, a mode of thinking suitable for covering economics as completely as possible.

Following this – especially with the redefinition of the frequency theory of probability – the principles of measurability and quantifiability became dominant, and complexity was expressed with probability distributions, expected values and

standard deviation as *compressed values*. Through this, the range of analytical possibilities was expanded but the complexity disappeared from the approaches. This process can also be described as the avoidance of complexity.

According to the authors, *an important question is why both acceptance and rejection of probability took place at the same time in the mainstream of economics. They emphasise the rise of formalisation in economics, which may have contributed to the decline of the uncertainty concept. They also advise that probability lost ground due to the joint impact of several economic factors. That is why economic theories have reduced probability to risk in calculable form.*

## 2 SUMMARY

In my opinion, the study is gap filling in addition to being of interest for a limited group of scholars. The topic selected is exceptional, its elaboration is extensive and it is based on a wide range of knowledge. It is well structured: by building the chapters one on another, the authors help the reader reach their conclusion, which may require a more specific interpretation regarding the question posed in the subtitle.

The authors discuss the evolution of the different versions of logical probability outside of economic thinking. One of their major findings is that – following the publication of TP – Keynes rested the problems of the theory of probability. On the other hand, the authors state Keynes could not completely part with the thread, since his ideas on it resurfaced in GT. The authors also point out that Keynes was not committed to the scholarly issues that induced the changes in economics he had introduced. Regarding the evolution of the versions of logical probability, they discuss the thought realm of Carnap (1950), Amsterdamski (1965), Pólya (1949), Hársing (1965,1971), Gillies (1988) and Popper (1934) and their correlations to the Keynesian philosophy of economics underlining Keynes' realisation (1921) noting „any additional knowledge we may possess has an even greater role than our statistical knowledge.”

In the second part of the paper the authors analyse the impact of the theory of probability on Keynes' economic thinking and point out that Keynes – talking about knowledge and being informed – „*means true statements whether or not they are direct or indirect knowledge*”. They also argue that Ramsey's (1931) statement regarding Keynes was key, as he confirmed rational belief in the context of certain knowledge alone. The authors reviewed and collided several concepts – O'Donnell (1990), Lawson (1988), Brady (1983), Skildesky (2011), Lucas (1977) – to come to relevant conclusions and to reveal correlations. As their final conclusion, they emphasise that answering these questions caused a dilemma in economics.

Based on the findings of the last chapter – “*The impact of probability on Keynes’ economic thinking*” – the question of the final implicit conclusion is raised again. Which question is answered in the authors’ study? Do they answer if Keynes’ theory of logical probability had an impact on economic thinking in general or if Keynes’ theory of logical probability had an impact on his own economic thinking? It can be said that the processing of a generous amount of literature supported the dilemma of economics with regard to accepting or rejecting uncertainty or whether other assessments can be formalised.

The authors come to the conclusion that the great thinkers’ different views on probability suggest the multiplication of the concept of probability. They also point out that is why competing concepts appeared in the 20th century as challengers. They state that this competition did not have a major impact on most thinkers of economics, they stayed with the analysis of „objective” and „subjective” without clearly explaining their content. As their final conclusion, they put forward the following statement: „*economics could only manage uncertainty - emphasising testing and extrapolation - by reducing it to a calculable form as risk.*”

To sum up, the theories, trends and analyses reviewed in the study lead to the final conclusion to say that Keynes’ theory of logical probability had an impact on his own economic thinking and also affected the economic thinking of his age, the next age and even of our days.

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7 Cf. BÉLYÁ CZ–DAUBNER (2020).

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