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Working Paper

Tracing dividing lines in the analysis of time and uncertainty: Keynes's logical probability and Ramsey's subjective probability in contrast

ZÖSS Discussion Paper, No. 129

Provided in Cooperation with:
University of Hamburg, Centre for Economic and Sociological Studies (CESS/ZÖSS)

Suggested Citation: Brüggemann, Kai (2026) : Tracing dividing lines in the analysis of time and uncertainty: Keynes's logical probability and Ramsey's subjective probability in contrast, ZÖSS Discussion Paper, No. 129, Universität Hamburg, Zentrum für Ökonomische und Soziologische Studien (ZÖSS), Hamburg

This Version is available at:
https://hdl.handle.net/10419/343056

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ZÖSS
ZENTRUM FÜR ÖKONOMISCHE
UND SOZIOLOGISCHE STUDIEN

ZÖSS-Discussion Papers
ISSN 1868-4947/129
Discussion Papers
Hamburg 2026

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Discussion Paper

ISSN 1868-4947/129

Zentrum für Ökonomische und Soziologische Studien

Universität Hamburg

Juli 2026

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Impressum:

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Herausgeber/Redaktion:

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Abstract

This article argues that Keynes´s inquiry into probability constitutes a theory of rational choice under uncertainty that is distinct from the subjective probability approach. Ramsey's theoretical treatment, in contrast to Keynes's, anticipates the mathematization of economic theory by introducing the possibility of numerically precise expressions of expectations under uncertainty. His essay reveals how this approach relies on idealized formalizations, most notably illustrated through the analogy between decision-making and betting. In doing so, Ramsey's account aims to provide a descriptive analysis of human behaviour under uncertainty. Both analyses indicate the limits to the mathematical inquiry of decisions under uncertainty by exposing the limits of induction. While this issue remains largely absent from Ramsey's analysis, it is constitutive of Keynes's account. Thus, although both approaches seek to develop concepts of rational choice under conditions of incomplete knowledge, the normative issues arising from the epistemic conception of uncertainty central to Keynes's analysis remain excluded from Ramsey's inquiry. Contrasting the two accounts reveals how distinct analyses of the economy can be traced back to different epistemic standpoints on uncertainty in decision-making.

1. Introduction

After the 100th anniversary of Keynes´s seminal work on probability, post- Keynesian scholars increasingly emphasized how this earlier philosophical work cannot be separated from his later macroeconomic theory (i.e. Carabelli 2021, p.10). At the same time, precisely the influence of Ramsey´s subjective probability approach, initially formulated as a criticism to Keynes *Treatise on Probability*, remains subject to an ongoing debate in history of economic thought publications (Bateman 2021; Gerrard 2023a). Ramsey's 1926 critique of Keynes's theory inspired ongoing debates in the history of economic thought, mostly centered around the continuity-or-change debate regarding the meaning of probability throughout Keynes's work. As already highlighted by Muchlinski (1996), the heterogeneity of the interpretations leave considerable difficulties to order these along these two discussion lines (Muchlinski 1996, p.114).

Recent publications, for example, highlight the intellectual environment of the scholars in interwar Cambridge and their common historical context (Marouzi 2024). Bateman (2021) as well as Gerrard (2023a, 2023b) discuss the extent to which Ramsey´s pragmatism influenced Keynes. Other contributions, such as Arthmar and Brady (2016) and Feduzi, Runde, and Zappia (2017) focus on the implication for a theory of decision making under uncertainty. Beyond these contributions, the profound philosophical nature of the debate motivates an analysis of the two accounts to reveal the distinct epistemologies underlying their respective approaches to analyse the economy. This article argues that Ramsey's analysis anticipated the expected utility approach as a theory of rational decision-making under uncertainty, whereas Keynes's perspective offers an alternative epistemological account of behaviour under uncertainty. This results in distinct interpretations of the functioning of the economy. In Keynes's approach, institutional conditions, including social norms regarding desirable outcomes and the epistemic conditions of knowledge acquisition, play a more important role in a theory of conduct under uncertainty.

2. Distinct legacies for the development of economic theory?

In an article on the history of rational choice theory in 20th century economics, Giocoli (2013 p.64) argues hat the extension of rational choice theory to decision-making under uncertainty remains an underexplored topic in the history of economic thought. In essence, Giocoli (2013, p.64) shows how the theory of rational expectations assumes agent behavior analogous to that of a Bayesian statistician: According to this theory, uncertainty is always captured in a quantitative probability distribution that is updated upon newly available information. Rational agents then act so as to "maximize the weighted average of probabilities and utilities". This individual perception of uncertainty as being based on probability distributions has developed as the subjective probability approach (Giocoli 2013, p.64). It has been discussed by Leonard Savage and Kenneth Arrow (i.e. Arrow 1978, p.159). Accordingly, the notion of a Bayesian decision maker developed as an underlying assumption of neoclassical equilibrium theory. As a theory of individual choice under uncertainty, it became a constitutive element to model the time contingency of markets (i.e. Debreu 1959).

This article starts from the observation that the notion of subjective probability was already treated by Ramsey in 1926. The furthermore interesting aspect is that Ramsey argued for his approach as a critique to Keynes´s understanding of probability. Given the particular meaning of uncertainty in Keynesian thought, highlighting the delineating aspects between the two concepts offers a potential to understand the subsequent development of economic theory.

More particular, this article contrasts Keynes´s account with Ramsey´s critique to reveal different epistemologies in the analysis of time and uncertainty. It argues that these leave distinguishable legacies for the posterior development of economic theory. While from a philosophical perspective, both accounts, Keynes´ logical probability and Ramsey´s subjective probability approach, are acknowledged to be distinct (Gillies 2000), this article seeks to illuminate different implications for an economic theory of uncertainty. This applies to the microeconomic meaning of uncertainty as unknown probabilities for a theory of individual choice under uncertainty which has been emphasized recently (Arthmar and Brady 2016; Basili and Zappia 2009; Feduzi, Runde, and Zappia 2017). From a macroeconomic perspective, abstracting from the behaviour of individual agents, the question arises as to how uncertainty influences macroeconomic phenomena. For example, Dow (2015) recently emphasized the particular meaning of epistemic uncertainty for economic crises, which underlies post-Keynesian thought. This perspective thus provides a distinct understanding of economic analysis prior to the establishment of microfoundations in macroeconomic modelling. How microfoundations established in macroeconomic analysis received particular attention among historians of economic thought after the 2008 crisis (i.e. Duarte and Lima 2012).

Frank P. Ramsey´s work is considerably less extensive than Keynes´s. His pioneering work in economics influenced the development of neoclassical growth theory in the 1950s, yet it remained largely overlooked by economists for many years (Duarte 2009, p.162). Ramsey thus especially advanced the use of mathematization in his economic theory, even though his intention in his formal inquiries are recently re-assessed by Duarte and Misak (2022) who revealed his hesitant perspective on utilitarian calculus. On the one hand, this highlights that a historical reading of his work suggests that later theoretical approaches to subjective probability may have incorrectly interpreted Ramsey´s account as a foundation of market theory. Furthermore, Ramsey's explorations were primarily intended as a general mathematical account of choice rather than as a contribution to economic theory.

On the other hand, the meaning of subjective probability for the neoclassical market equilibrium calculus is of great significance. An intriguing aspect considered in this article is that his account of subjective probability, as developed in the 1926 essay, is essentially already similar to the expected utility approach later advanced by Bruno de Finetti and Leonard Savage (e.g. Runde 1994, p.97). In acknowledging the distinct meaning of Keynesian uncertainty in contrast to the neoclassical approach, the two accounts from Keynes and Ramsey represent a watershed in the development of economic theory. However, this does not refer as much to the meaning for individual choice, as to the macroeconomic implications of uncertainty.

3. Keynes`s theory of logical probability

Keynes´s epistemological approach, as developed in his *treatise on probability* (treatise henceforth), is a theory of logical probability. It pertains to the logic underlying the establishment of a probabilistic relationship, specifically as a connection between a knowledge hypothesis and the empirical evidence that supports it. Accordingly, a logical relation between premises and hypothesis exists independent of any causal relationship between two variables. The approach pinpoints to a reasonable way of thinking about probabilities in an environment where only partial knowledge about probability relations is available (Carabelli 2021, p. 14). Keynes´s intention in *the treatise* is to regard probability from an epistemic perspective. He assumes a subjective and incomplete nature of knowledge on probabilities. Objectiveness[2] stems merely from the logical relationship between propositions (Keynes 1973 [1921], p.4). The particular evidence forming probability beliefs is in that contrast of subjective nature (Keynes 1973 [1921], p.19).

In chapter 2 of the treatise on probability Keynes (1973 [1921]) states this relationship according to the following form: Given a proposition *p* and evidence, such as a set of propositions *h*, supporting the proposition *p*, then a rational degree of belief is the degree α that corresponds to the probability that $h \rightarrow p$. The proposition *q* corresponds to the knowledge of the probability relation α. The proposition p serves as a primary condition. The proposition *q*, involving *a* probability relation and hence the contemplation of logic, is considered a secondary proposition. Certainty, that *p* follows from *h*, corresponds to $\alpha=1$ (Keynes 1973 [1921], p.11). Keynes emphasizes that the perception of probability relations as logical relationships depend on individual knowledge (Keynes 1973 [1921], p.35). Gerrard (2023a) states Keynes´s concept in the simpler form, given the proposition *p* and evidence *h*, probability yields $\alpha=\frac{p}{h}$ (Gerrard 2023a, p. 385), while *α* denotes the degree of partial belief. Logically, sets of propositions combining evidence and hypothesis in the above manner denote arguments on probability relations (Keynes 1973 [1921], p.22).

This formulation construes the concept of probability as a theory of partial belief, i.e. belief in a proposition given limited evidence. This emphasizes the epistemic nature of probability i.e. probability as naturally related to knowledge, and therefore a philosophical category. By this definition, probability judgements are by their nature subject to epistemic uncertainty. Only in the limiting cases probability equals knowledge and, therefore, certainty. Keynes defines a degree of rational belief according to the logical reasoning as suggested by the theory of logical probability (Keynes 1973 [1921], p.339). Consequently, rationality merely derives from the application of logic to probability judgements. Logic, as consistency between premises and conclusions, becomes a guide how rational decisions on uncertain outcomes ought to be conducted. However, premises can be of very different nature, not only based on quantitatively measurable observations.

[2] Objectivity, as employed here, implies that if two individuals possess the same logical reasoning skills and observe the same information, they would arrive at the same conclusions regarding probability relations. The laws of logic are in that regard “not subject to human caprice” (Keynes 1973, p.4).

4. Vagueness in logical probability arguments

In contrast to the approach employed by Ramsey, Keynes emphasized that the majority of probability relations is not precisely measurable in numerical terms (Keynes 1973 [1921], p.176). For comparing different arguments on probability relations, as it is necessary for rational decision making under incomplete knowledge, the numerical expression receives critical relevance. In chapter 3 of the *Treatise on Probability* Keynes emphasizes the complexity which comes with the difference in "ascertaining numbers in certain cases from a supposed difficulty of expression by means of numbers." (Keynes 1973 [1921], p.22) In so doing, Keynes opposes to the common approach to establishing a theory of decision-making under uncertainty by relying on numerical expressions of probability in practical cases, such as in the case of insurances (Keynes 1973 [1921], p.25). This rejection of a subjectively precise expression of probabilities as a theory of probability contrasts to the later employed subjective probability (i.e. expected utility) argument. As shown below, Keynes indeed sees such practice rooted in a theory of gambling but not rational choice. The logical account instead seeks to integrate the internal reasoning capabilities of a human mind (i.e. logic) with the external conditions that allow for probability judgements.

First, Keynes rejects a universal expression of probabilities on the theoretical grounds that the effect of further evidence for an inductive argument (which is the form of his logical approach to probability) cannot always be precisely maintained. He exemplifies this with a series of experiments supporting a conclusion. Every experiment in which unessential conditions are varied increases the probability of the conclusion. However, the precise numerical increase cannot be measured by a general principle (Keynes 1973 [1921], p.30).

Second, for a comparison of different probability arguments, these need to be on the same order of magnitude. This is not the case for different sets of experiments, when for some the set is larger, and another set yields a wider generalization (Keynes 1973 [1921], p.32). Thus, probabilities need not only to be numerically determined, but also be on the same order of magnitude to yield a basis for rational decisions on precise numerical grounds. This account indicates the peculiar existence of non- numerical probabilities. For the case that a probability can be precisely measured, this measurement must yield an ordering that allows for a comparison with other probability assessments. These are the specific epistemic features of probabilities according to Keynes' account. Keynes concludes, that, in consequence, for some pairs of conclusions a numerical comparison is possible, and for others there is no ground for comparison. For a third class a comparison in terms of greater and less is possible (Keynes 1973 [1921], p.37).

The account reconstructed above indicates the difficulties for rational choice under uncertainty upon stochastic measures. Relevant for an analysis of choice under uncertainty, Keynes develops in his *Treatise* an interval value approach to compare probabilities. This has recently been highlighted by scholars investigating the history of decision theory (Arthmar and Brady 2016; Feduzi, Runde, and Zappia 2017). The interval- valued approach considers probabilities within a bounded range. Following upon the above presented account, only in

the limiting cases of probability (i.e. certainty or impossibility) a precise statement is possible[3]. With this approach Keynes (1973 [1921]) puts initially non- numerical probabilities on an order that allows for comparison. In chapter 26, in discussing the logical approach to a theory of conduct, Keynes refines the coefficient of weight with an analysis of risk. The closer the upper and lower bound of a probability range are together, the higher is the weight of the probability argument (Keynes 1973 [1921], p.348). In that regard, a formal exploration of uncertainty is possible. Accordingly, a greater body of evidence increases the weight of an argument.

Arthmar and Brady (2016) emphasize the indeterminate nature of probabilities in Keynes´s epistemology of probability. Even though the interval- valued approach allows for a comparison of initially non- numerical probabilities, precise relations may remain unknown throughout time (Arthmar and Brady 2016, p.108). From an epistemic perspective, the notion of indeterminate probabilities emphasizes that no further observation can be expected to uncover existing causal probability relations. What is important, is that according to Keynes´s account, rational decision making cannot be numerical precise in the majority of the cases. This imprecision stems from probability relations that are unknown and can be observed in theory, but also from cases in which probability relations do not exist (Keynes 1973 [1921], p.34). Overall, this theory contrasts with the subjective probability argument and the mathematical precision of neoclassical equilibrium calculus later constructed upon it.

Furthermore, Keynes (1973 [1921]) raises ethical concerns regarding the measurability of goodness. Precise rational decisions involving goodness must yield a quantitative measurability: “The hope, which sustained many investigators (…) of bringing the moral sciences under the sway of mathematical reasoning, steadily recedes – if we mean, as they meant, by mathematics the introduction of precise numerical methods” (Keynes 1973 [1921], p.349). In chapter 26 of the *treatise on probability* Keynes accordingly rejects the unconditioned numerical formulation of decision problems on the basis that neither the degree of goodness, nor probability relations are precisely measurable (Keynes 1973 [1921], p.343). This leads him to cast doubt on the mathematical expectation that he sees mostly placed in “the theory of gambling” (Keynes 1973 [1921], p.344), as an appropriate account of individual decision making (p.344). It is this epistemically grounded difference in the analysis of decisions under uncertainty that distinguishes Keynes’s concept of rationality. It sets Keynes’ approach in the *Treatise on Probability* apart from contemporarily developing subjective probability approaches. Even though the interval-value approach aims at numerical comparison by accounting for both risk and the weight of argument, some imprecision remains.

The implication of Keynes´ account are twofold. Firstly, decisions on uncertain outcomes are imprecise by the epistemic nature of probability assessments. The development of the interval valued approach however indicates how Keynes was concerned with formally challenging this problem. This underlines the ideal that logic is a guide for how decisions ought to be conducted. Secondly, if the betting quotient method underlying the expected-utility approach provides a descriptive account of decision-making under uncertainty, as illustrated by the

[3] At the end of chapter 15 of the *Treatise* Keynes develops a refined version of George Boole's method to approximate non-numerical probabilities (Keynes 1973, p.179). The method is explained in more detail by Arthmar and Brady (2016, p.109)

insurer example, then Keynes is focused on a prescriptive account. Keynes´s approach aims to guide how decisions should be made rather than merely approximating how they are made. In this context, the degree of goodness receives critical meaning.

While the betting quotient method describes actual behavior in uncertain situations, Keynes focuses on a normative analysis of this behavior under uncertainty. This account furthermore shrinks the possibility space for a precise mathematical analysis of economic phenomena in terms of optimization. Instead, qualitative assessments of decisions under uncertainty receive more attention, even though Keynes´ account in the *Treatise on Probability* is not worked out on this topic (Basili and Zappia 2009, p.428). Considering Keynes's discussion of the degree of goodness, the ethical implications of uncertainty and decision outcomes play a constitutive role in his theory of decision-making.

5. Ramsey's theory of subjective probability: Rational choice as betting

The subjective probability account by Ramsey (1990 [1926]) pioneered the axiomatization of subjective beliefs under uncertainty. Similarly to his theory of optimal saving, the subjective probability argument as developed in his essay long remained unconsidered to important theorists of expected utility (Düppe and Weintraub 2014, p.46). The controversy with Keynes is particularly interesting because it contrasts two distinct analyses of uncertainty in decision-making that underly the subsequent development of economic theory in 20th century economics.

In his 1926 essay *Truth and Probability* Ramsey (1990 [1926]) essentially contests the suggestion that the logical probability relations, as formulated by Keynes, descriptively correspond to degrees of belief hold by an individual. Ramsey (1990 [1926]) depicts his argument as a critical response to Keynes´s account. His 1926 essay formally develops the critique he already put forward in a less extensive article for the *Cambridge Magazine* in 1922 when he was still an undergraduate (Gerrard 2023b, p.199) as well as in a private letter exchanges with Keynes (Marouzi 2024, p.12).

First, Ramsey (1990 [1926], p.58) questions to analyze individual beliefs according to the laws of logic and therefore as a practical method for individual decision-making. Second, he rejects the assumption that degrees of belief ought to be based on laws of logic for yielding empirical truth. He doubts that a degree of belief guided by a logical relationship between a set of propositions, as proposed by Keynes, is the best guide yielding that degree of belief being causally true (Ramsey 1990 [1926], p.61). The difficulty consists in assigning to logically determined degrees of belief a causal relationship.

Ramsey (1990 [1926], p.63) then continues to reject the division made by Keynes in measurable and non- measurable beliefs. Instead, some can be measured more accurately [4] than others. For the purpose of this article this passage is noteworthy. The numerical representation of individual partial beliefs in probability relations marks an important

[4] Here, accuracy refers to empirical truth, while precision means a numerical and unique expression. As shown in this section, Ramsey´s account depicts all subjective probability judgements numerically and therefore precisely measurable.

difference from Keynes's approach. Ramsey clearly articulates his ideal of a precise numerical measurement. He depicts this analysis of individual decision-making under uncertainty as analogous to precise axiomatic reasoning in physics—an approach that he believes could not be rejected (Ramsey 1990 [1926], p.66). But against Keynes, he intends to describe human decisions, and not to develop an account on how decision ought to be conducted by themself. From the definition of a degree of belief as a "causal property of it[self], which we can express vaguely as the extent to which we are prepared to act on it" Ramsey (1990 [1926], p. 65) develops the mathematical framework for presenting degrees of belief.

Ramsey essentially perceives the procedure of how to identify different degrees of belief as analogous to bets. For the economic implication, it is worth noting his critical reflections on the bet- analogy. He discusses how risk aversion varies among individuals and how it limits the interpretation of bets as equivalent to rational behavior. [5]

Furthermore, in dedicatedly avoiding a normative discussion of the actual good in decision making, he aims for stating a "theory that we act in the way we think most likely to realize the objects of our desires, so that a person´s action are completely determined by his desires and opinions" (Ramsey 1990 [1926], p.69). This underlines the objective of construing a descriptive account on individual decision making. He refrains from a narrow reference to a utilitarian account, instead continuing to propose to call "the things a person ultimately desires goods" and to "assume that they are numerically measurable and additive." (Ramsey 1990 [1926], p.69). The defined good does not equal good in the utilitarian sense, but "things that we want, which may be our own or other people´s pleasure, or anything else whatever (…)" (Ramsey 1990 [1926], p.69).

In his 1926 essay, Ramsey develops a mathematical derivation based on a hypothetical individual expressing preferences over alternative states of the world. From these axiomatic statements Ramsey (1990 [1926], p.77) proves the laws of probability. Consequently, it is this formally derived relationship constituting the link between individual preferences and probability relations that came to form expected utility argument that is pioneered by Ramsey in his 1926 essay. Accordingly, the axiomatic derivation of this theory builds upon individual choice between alternatives that yield the highest satisfaction of desires. When combined with subjective probability assessments, this approach reveals important similarities with the expected utility approach developed in later economic theory.

The betting quotient analogy is also used by later economists Bruno di Finetti and Leonard Savage (Feduzi, Runde, and Zappia 2017, p.212), who continued to develop the expected utility argument. This argument, as refined by the mentioned economists, developed into the neoclassical paradigm for the analysis of individual decisions under uncertainty and became a dominating perspective on the subject (Runde 1994, p.97).

[5] This hesitance can be understood as a doubt whether the betting quotient method readily describes economic behavior in the real world. Instead, Ramsey formulated his account as a "useful approximation to the truth particularly in the case of our self- conscious or professional life" (Ramsey 1990 [1926], p.69).

6. Keynes and Ramsey in contrast

As a theory of decision-making under uncertainty, Ramsey´s 1926 account ensures logical consistency. It entails the connection between personal preferences and an uncertain future under the subjective probability approach. This contrasts with the account Keynes presents in the *Treatise*. As stated in chapter 26 of the *Treatise*, Keynes unambiguously refrains from a precise and unconditional integration of conduct and probability. Besides the vagueness of probability, Keynes also casts doubt on the measurability of goodness. Ramsey´s account stands in contrast to this hesitance by regarding probability and preferences as integrated under laws of consistency. Importantly, this view paves the way for analyzing individual decisions in precise numerical terms. This underlies the time contingency of markets as modeled with the general equilibrium approach and Debreu´ s (1959) extension for possible states of the world in the future (Arrow and Debreu 1954; Debreu 1959).

Eventually both authors, Keynes and Ramsey, are driven by the motive to give an account on rationality. For both authors an analysis of probability judgements must consider the capabilities of the human mind and thus focus on individual decisions. Fort both, probability judgements are a theory of partial belief and essentially an epistemological concern. The difference lies in how individual decisions under uncertainty are conceptualized. Ramsey seeks a mathematically precise and descriptive account of choice, whereas Keynes emphasizes the epistemic conditions and normative dimensions of decision-making under uncertainty.

For Ramsey (1990 [1926]) the focus lies on an analysis of individual decision making in an environment of incomplete knowledge of future states of the world. Ramsey´s *Truth and Probability* constructs a descriptive account, focusing on a mathematical theory of human behavior. He on a descriptive view on the human psychology on probability judgements. On the one hand he assumes error to be a natural feature of the human mind (Ramsey 1990 [1926], p.80). Furthermore, as evident from his formal treatment and also recently postulated by Duarte and Misak (2022, p.45), Ramsey perceived a one to one relationship between mathematics of probability and degrees of belief as an idealized analysis of a degree of belief.

He emphasizes how numerical precision in the analysis of probability judgements does not eliminate vagueness: “(…) the ideally best thing is that we should have beliefs of degree 1 in all true propositions and beliefs of degree 0 in all false propositions. But this is too high a standard to expect of mortal men, and we must agree that some degree of doubt or even of error may be humanly speaking justified.” (Ramsey 1990 [1926], p.80). Instead, he gives a consistent account of preferences and knowledge on probabilities.

On the other hand, and in contrast to the non- existence of some probability relations in Keynes´s account, the subjective probability approach allows for constant learning about all probability relations. This view is eventually perpetuated by stating that scientific methods constantly improve (Ramsey 1990 [1926], p.94). This perspective depicts the analogy to the later established Bayesian- decision maker in economic theory. A close reading of Ramsey´s essay however reveals, how this account focuses on internal mathematical consistency between preferences and (subjective) expectations.

In his *Treatise*, Keynes formulated inductive arguments as arguments of partial belief. Within the concept of logical probability, these arguments are understood as arguments on

probability relations. Ramsey criticizes this view that stems from the difficulty to justify *a priori* probabilities, but avoids taking up this epistemic problem. An inquiry into the justification of a priori probabilities would be a "meaningless question; and even if it had a meaning, I do not see how it could be answered." (Ramsey 1990 [1926], p.88). Ramsey refrains from a philosophical discussion. Instead, his concept of a "human logic" at the end of his essay generally refers to a "rule or habit" (Ramsey 1990 [1926], p.91) allowing for inferences, clearly mentioning inductive reasoning as such a method.

It is this relation of logical consistency to empirical facts that was of more concern for Keynes´ work. Henceforth, Ramsey does not fully work out this concept of human reasoning. Rationality in Ramsey´s terms depicts the consistency of individual preferences with knowledge on probabilities as a "law of psychology" (Ramsey 1990, p. 70). Ramsey thus emphasizes how a descriptive measurement of degrees of belief does not constitute a particular explanation of how these emerge.

Ramsey thus only shortly referred to the mental conditions of probability judgements. He was eventually critical of utility maximization as a method to assess economic decisions normatively, pinpointing the descriptive character of his inquiry. Later, for Ramsey´s economic analysis as conducted in his essay on optimal saving in 1928, the concept of utility receives critical significance. In Ramsey´s view, utility differs among individuals in the economy and cannot be uniquely compared among them (Duarte and Misak 2022, p.48).

Keynes adhered to Ramsey´s subjective probability approach in an obituary article published in *The New Statesman and Nation* shortly after Ramsey´s death in 1931. In that, he admits the idealistic conception of logic as an objective guide to probability judgements. At the same time, he seems to be unsatisfied with the justification of induction as a useful habit: "Ramsey argues (…) that probability is concerned not with objective relations between propositions but (in some sense) with degrees of belief and he succeeds in showing that the calculus of probabilities simply amounts to a set of rules for ensuring that the system of degrees of belief which we hold shall be a consistent system. (…) I yield to Ramsey- I think he is right. But in attempting to distinguish ´rational´ degrees of belief from belief in general he was not yet, I think, quite successful." (Keynes 1931, p.339).

As this passage indicates, Keynes was concerned with empirically informed rationality as a normative guide to assess choices under uncertainty. The concept of human logic in Ramsey's approach refers to judgments guided by useful rules and habits, such as induction. This fuzzy perspective suggests that Keynes's ideal of a theory of choice under uncertainty remains unfulfilled. From a descriptive perspective on human cognitive abilities, Ramsey's account provides a mathematically precise approximation of human decision-making. It is the view that Ramsey illustrates in his 1926 essay with the encompassing bet analogy that allows for such a representation of human choices: "Whenever we go to the station we are betting that a train will really run, and if we had not a sufficient degree of belief in this we should decline the bet and stay at home." (Ramsey 1990 [1926], p.79). At the same time, at the beginning of his essay, he admits that this theoretical approach requires "a certain amount of hypothesis or fiction" (Ramsey 1990 [1926], p.64).

7. From epistemologies of probability to a precise representation of decisions under uncertainty?

The most debated aspect in the history of economic thought is the influence Ramsey had on Keynes´ view on the philosophy of probability and economic theory. This found most consideration in the mentioned continuity- or- change debate that emerged with a spurring re- interest in the *Treatise* after its publication with an editorial forward by Braithwaite (Gerarrd 2023, p.197). Braithwaite argues, on the basis of the mentioned obituary article in the *New Statesman* that "Keynes might not be unsympathetic to the ´restricted betting-quotient´ theory" (Keynes 1973 [1921], xxii). While also lately some scholars highlight Keynes appreciation for a subjective probability approach to economics and an acceptance of Ramsey´s critique and a profound and increasing influence of Ramsey´s pragmatism (Bateman 1987, 2021), others keep proclaiming the opposite (Carabelli 2021).

Gillies (2000) as well as Marouzi (2024) contextualize Keynes´s early thought in the Cambridge environment of the early 20th century. Then, analytical philosophy after Bertrand Russel and G.E. Moore inspired the young scholar Keynes. Bertrand Russel, whose lectures Keynes attended, established a philosophical account of mathematics in the way of a purely axiomatic reasoning. Keynes, in challenging this framework with the possibility of guidance for action, emphasizes the need to relate logic to empirical evidence. Thus, without turning onto an entirely inductive framework the *treatise* is concerned with a theory of partial knowledge (Gillies 2000, p.28). In fact, Keynes was praised by Russel himself for discovering the "true logic of induction" (Bateman 1987, p.103).Marouzi (2024, p.4) recently emphasized the intellectual environment of both Cambridge scholars. Ramsey and Keynes were spurred by the goal to find a deeper sense of rational action, as reasonableness in human behavior. Keynes and Ramsey were both rooted in the contemporary intellectualist tradition among the Bloomsbury group. As Keynes, Ramsey was closely aligned with the Bloomsbury group.

In essence, Keynes´s and Ramsey´s account contrast with regard to the conditions that allow rational choice to realize. Furthermore, Muchlinski (1996, p.89) utilizes the dualism of the inner and the outside world explaining Keynes´s epistemology. Accordingly, Keynes did not assume a subject existing independently of an outside world that unconditionally allows for objectively observing facts. Ultimately, this emphasizes the importance of the economic and social context in which individuals make decisions, as well as the norms that shape conceptions of desirable outcomes. This provides the basis for an understanding of individual choice that incorporates the broader social and economic environment of the decision-maker. In this perspective, institutions become important elements in theories of choice under uncertainty developed after Keynes's *Treatise*. Conversely, Ramsey adheres to the consistency of choice and individual knowledge, focusing on a psychological description. In his context, consistency in preferences and expectations represents a descriptive theory of rational choice under uncertainty.

8. Concluding Remarks

The epistemic issue of uncertainty in probability judgments, as discussed in the *Treatise on Probability*, highlights the distinctive notion of Keynesian uncertainty (Dow 2015, p.34).With his logical approach, Keynes investigates the conditions necessary for precise probability judgements. These conditions restrict numerically precise judgements in the majority of the cases. Moreover, he unambiguously reaches the conclusion that there are situations in which empirically guided thought concerning an uncertain future is impossible. Conversely, through his account of subjective probability, Ramsey (1990 [1926]) anticipated later approaches to decision-making under uncertainty based on rational expectations, which came to dominate economics from the second half of the 20th century onwards. This perspective treats uncertainty primarily through probabilistic assessments of future outcomes as bets on an uncertain future.

From the perspective of the history of economic thought, an intriguing aspect is that subsequent branches of economic theory reflect distinct interpretations of these accounts, with some rejecting the view that Keynes accepted Ramsey's criticism as the basis for a theory of decision-making under uncertainty. Post- Keynesian scholars aligning with the particular Keynesian notion of uncertainty assume an open- system ontology of the economy. According to this view, the economy is driven by uncertainties that cannot become knowable by their nature (Dow 2015, p.36). In consequence, institutions and conventions receive peculiar importance within an economy, highlighting the importance of normativity in a theory of conduct. Uncertainty perceived in this kind especially finds consideration in the literature by the "Keynesian fundamentalists" (Basili and Zappia 2009, p.420) who focus on the development of economic theory upon this Keynesian notion of uncertainty. This branch was later for example developed in the work of G.L.S. Shackle (i.e. Shackle 1958). The key issue is that the nature of probabilities may limit the possibility of individual assessments in situations of uncertainty. In turn, this requires an analysis of the economy that extends beyond individual decision-making. Uncertainty limits a formal analysis of the economy as a system governed by subjective probabilities and dynamic equilibrium.

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