

Theoretical and Practical Research in Economic Fields

Quarterly

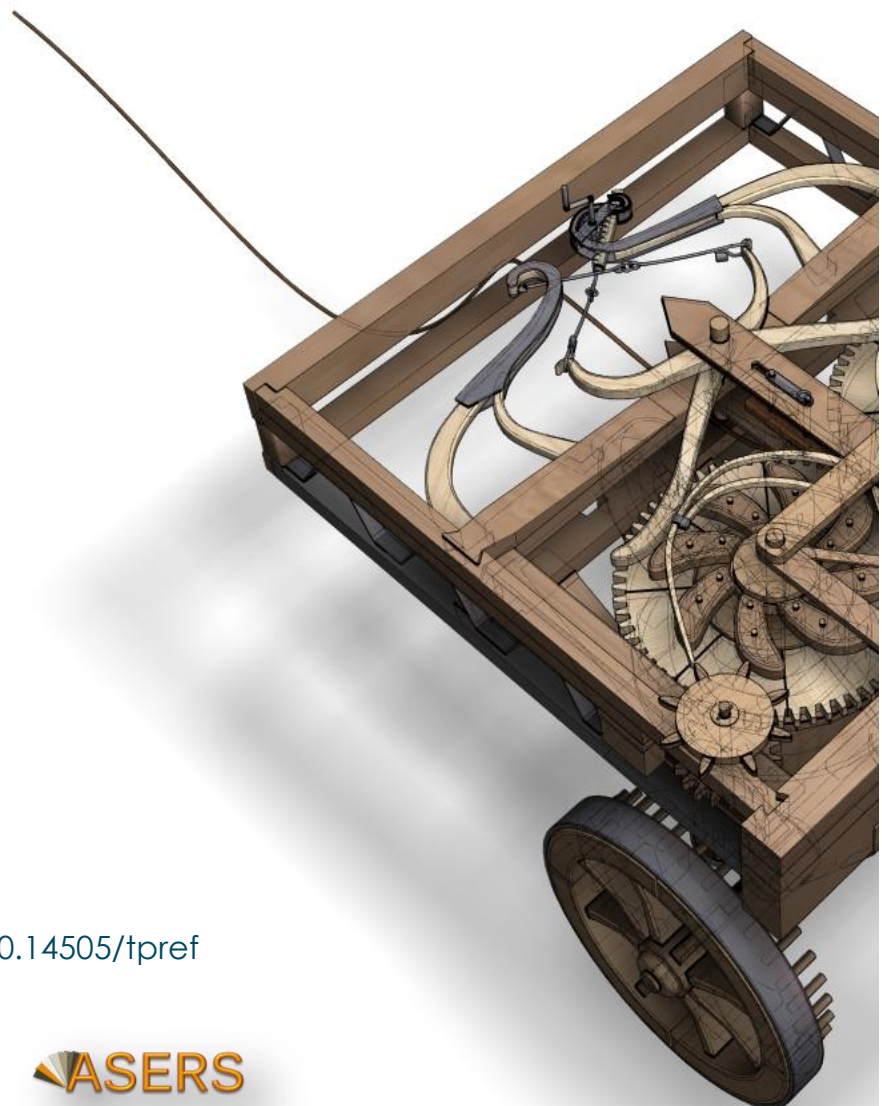
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J. M. Keynes, *The General Theory* and George Boole: Keynes's Uncertainty is based on Boolean Uncertainty as analyzed in *The Laws of Thought*

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Abstract: This paper contributes to the literature on Keynes by showing that Keynes's understanding and analysis of the role of uncertainty in decision making originated from his reading of George Boole's *The Laws of Thought*. Boole's *The Laws of Thought* was the first mathematically and logically advanced treatise (Thomas Aquinas and Adam Smith had both recognized that real world decision making could not be based on the purely mathematical laws of the probability calculus) on uncertainty, demonstrating that the purely mathematical laws of the probability calculus, based on additivity and linearity were, at best, only a limiting, special case that would rarely occur in the real world of decision making which were characterized by non-additivity and non-linearity. Keynes then developed the basic foundational analysis of Boole further in his *A Treatise on Probability* and *General Theory*. Keynes advanced Boole's theory by developing his own version of Boole's logical, objective, probability relation, theory of groups, upper-lower, interval bounded imprecise probabilities, as well as the evidential weight of the argument, which would allow a treatment of uncertainty in the form of a decision weight approach instead of by interval estimates. Keynes called this approach his conventional coefficient of weight and risk, c , in Chapter XXVI of the *A Treatise on Probability*.

Keywords: Boole, Keynes; missing/unavailable data or information; non-probabilistic uncertainty; decision weights; imprecise probability; interval valued probability.

JEL Classification: D81; E12.

Introduction

The paper will be organized in the following manner. Section Two will examine Boolean Uncertainty, which, like Keynesian uncertainty, is based on a decision situation composed of both partial ignorance and partial knowledge. Partial ignorance means that only a partial ordering of the probability space is possible, which means that measurement must be incomplete. Section Three will examine Boole's understanding that the formation of expectations can't possibly be based on purely precise probability and strict or exact mathematical expectations because mathematical expectation calculations do not deal with/incorporate missing/unavailable information and/or incorporate 'animal spirits', which involve the mental and emotional aspects involved in the expectations formation of the decision maker. Section Four will cover Boole's criticisms of the Laplace approach to probability, a criticism which Keynes incorporated into his (1973), for which he was heavily criticized. None of Keynes's critics pointed out that Keynes's criticisms of Laplace are just a more emphatic and vocalized version of the criticisms first made by Boole in (1854):

"The most usual mode of endeavouring to evade the necessary arbitrariness of the solution of problems in the theory of probabilities which rest upon insufficient data, is to assign to some element whose real probability is unknown all possible degrees of probability; to suppose that these degrees of probability are themselves equally probable; ... It has been said that the principle involved in the above and in similar applications is that of the equal distribution of our knowledge, or rather of our ignorance - the assigning to different states of things of which we know nothing, and upon the very ground that we know nothing, equal

degrees of probability. I apprehend, however, that this is arbitrary method of procedure." (Boole 1854, 369-370; italics added).

Boole's rejection of any equal distribution of ignorance assumption, in order to support the assumption of equal a priori probabilities, leads directly to Keynes' 's major modifications of the Principle of Indifference in (Keynes 1921/1973; 1973), which is that the knowledge must be positive and symmetric for all alternatives. Given the problems of meeting this condition in actual practice, it means that the priori probabilities will usually be imprecise:

"15. This distinction enables us to formulate the Principle of Indifference at any rate more precisely. There must be no relevant evidence relating to one alternative, unless there is corresponding evidence relating to the other; *our relevant evidence, that is to say, must be symmetrical with regard to the alternatives, and must be applicable to each in the same manner. This is the rule at which the Principle of Indifference somewhat obscurely aims.* We must first determine what parts of our evidence are relevant on the whole by a series of judgments of relevance, not easily reduced to rule, of the type described above. *If this relevant evidence is of the same form for both alternatives, then the Principle authorizes a judgment of indifference.*" (Keynes 1921, 1973, 55-56, italics added).

Keynes's symmetrical requirement now allows us to clear up the very severe confusions of philosophers regarding Keynes's Principle of Indifference in theory, if not in practice. Contrary to current thought, Keynes never rejected the Principle of Indifference (POI) in (Keynes 1936). What he rejected was the Bernoulli-Laplace Principle of Non-Sufficient Reason:

"Nor can we rationalize our behaviour by arguing that to a man *in a state of ignorance* errors in either direction is equally probable, so that there remains a mean actuarial expectation based on equi-probabilities. For it can easily be shown that the assumption of arithmetically equal probabilities *based on a state of ignorance leads to absurdities.*" (Keynes 1936, 152; italics added).

What Keynes has rejected above on page 152 of Keynes (1936) is the Bernoulli-Laplace version of the POI, based on equally balanced ignorance, that appears on p. 42 of Keynes (1921, 1973) and not his version of the POI, which is based on equally balanced, positive knowledge, as first pointed out by Boole, that appears on pp.54-56 and p.160 of Keynes (1921, 1973).

Keynes supports Boole's development of techniques to estimate, as opposed to calculating, the priori and a posteriori probability by incorporating constants into the a priori formulations of the probabilities that stand for the missing or unavailable information. These techniques are illustrated by Keynes in chapters XV, XVI and XVII of Keynes (1921, 1973). Section 5 will conclude the paper.

1. Review of the Literature on the Boole - Keynes Connection

Unfortunately, there is no literature to review from economists, philosophers, social scientists and behavioral scientists except for the work of Hailperin (1986). Hailperin, a mathematician, recognized Keynes's debt to Boole as regards the application of Boole's relational, propositional logic and interval valued probability. Outside of Hailperin's work, there is simply no literature to review. Consider the following assessments of Boole's work made by Corcoran and Burris, who are both logicians:

"Accordingly, this article does not discuss many other historically and philosophically important aspects of Boole's book, e.g. his confused attempt to apply differential calculus to logic, his misguided effort to make his system of 'class logic' serve as a kind of 'truth-functional logic', *his now almost forgotten foray into probability theory*, or his blindness to the fact that a truth-functional combination of equations that follows from a given truth-functional combination of equations need not follow truth-functionally. One of the main conclusions is that Boole's contribution widened logic and changed its nature to such an extent that he fully deserves to share with Aristotle the status of being a founding figure in logic. By setting forth in clear and systematic fashion the basic methods for establishing validity and for establishing invalidity, Aristotle became the founder of logic as formal epistemology. By making the first unmistakable steps toward opening logic to the study of 'laws of thought'—tautologies and laws such as excluded middle and non-contradiction—Boole became the founder of logic as formal ontology." (Corcoran 2003, 261, italics added).

Consider now Burris's apparently unfinished manuscript that aims to explain Boole's book using comments in the margins that are appended to Boole's original text. The following one sentence comment is all that appears as regards Boole's chapters in Boole (1854), XVI to XXII:

"Boole viewed Logic as a prerequisite for Probability Theory." (Burris 2022, 13).

This is the only mention made of probability in Burris's excellent explanation of what Boole is doing in chapters I to XV of LT. Consider Keynes's summary of his position that classical and neoclassical economic theory were special cases of his general theory:

"I shall argue that the postulates of the classical theory are applicable to a special case only and not to the general case, the situation which it assumes being a limiting point of the possible positions of equilibrium. Moreover, the characteristics of the special case assumed by the classical theory happen not to be those of the economic society in which we actually live, with the result that its teaching is misleading and disastrous if we attempt to apply it to the facts of experience." (Keynes 1936, 3).

Keynes's conclusion follows directly from Boole's general theory of decision making, that incorporated precise probability and strict mathematical expectations as being special cases of the general case of imprecise probability and approximate expectations.

Of course, the postulates of classical, neoclassical, new classical and new neoclassical economics are all fundamentally based on the purely mathematical laws of the calculus of probability, which require additivity and linearity as being necessary to perform any type of economic analysis. Modern neoclassical economists are as ignorant of Boole's logic based, relational, propositional system as are all heterodox economists. Keynes, following Boole, recognizes that all economic results based on mathematical expectations can, at best, be only special cases of a general case. The general case requires the incorporation of non-linearity and non-additivity into economic analysis, which is required for the existence of Boolean and Keynesian uncertainty.

Similarly, ideas such as Keynes's views on the Principle of Indifference, expectations, and 'animal spirits' derive from Boole's discussions and analysis of these topics that are contained in Boole (1854).

Since there have been no papers written in either the 20th or 21st centuries on what can be called the Boole-Keynes connection, except for my papers and those of my co-authors, all past and current work on Keynes's (1921, 1973; 1973) and/or Keynes (1936) is either (a) incomplete, or (b) deficient and defective. This current state of affairs will require that all past work done on Keynes's (1921, 1973; 1973) and/or Keynes (1936) and/or the connections/links between the two books will have to be restudied, reevaluated, redrafted and rewritten. The economic and philosophy professions can thus be seen to be back at a 1969 position as regards Keynes's works. It was in 1969 that Hishiyama (1969) pointed out that (Keynes 1921, 1973) had not been read, leading to a situation where the connections between (1921, 1973; 1973) and Keynes (1936) had been overlooked. It is impossible to restate Keynes's positions correctly unless it is recognized that Keynes, like Boole, Smith and Aquinas before him, rejected precise, numerical, mathematical probability, in general, while following methods of imprecise and indeterminate, interval valued probability, which is necessary for the specification and analysis of Keynesian uncertainty.

2. Research Result. Wilson on Boole and Keynes

Consider the following statement:

"Two other quotations may be of interest: (1) "The theory of 'Testimony, ...of the combination of the testimony of witnesses, ...has occupied so considerable a space in the traditional treatment of Probability that it will be worthwhile to examine it briefly. It may, however, be safely said that the principal conclusions on the subject set out by Condorcet, Laplace, Poisson, Cournot and Boole are demonstrably false. The interest of the discussion is chiefly due to the memory of these distinguished failures" (p. 180). Never perhaps since ancient biblical times has such a redoubtable army of philistines been so deftly slain (Keynes, XV, 15)." (Wilson 1923, 319).

Keynes is correct here, in general. However, he should have noted that Boole is correct based on his deployment of the POI, although this was a case where Boole should not have used the POI, about which Boole correctly stated that it could be used only if there was positive knowledge (Boole 1854, 368-371).

Now consider the following statement:

"To understand Keynes, one has constantly to bear in mind that he is of the philosophic not of the mathematical school, that he derives from Leibniz, Hume and Venn rather than from Bernoulli, Laplace, and Charlier. He is seeking to lay a logical foundation for probability and to examine that foundation in the light of a wide reading of philosophic, mathematical, and statistical works on probability." (Wilson 1923, 320).

Unfortunately, Wilson, because he skipped Part II of Keynes (1921, 1973) in his first review of Keynes (1921, 1973), failed to realize that, in fact, Keynes is building on only one predecessor, George Boole. He is not building on Hume, Locke, von Kries, or Leibniz, because the content of the contributions of Hume, Locke, von Kries, or Leibniz, while discernable, is actually quite small when compared to Keynes's conclusion that Boole,

alone, had made the only major contribution of which Keynes was aware in Keynes (1921, 1973, 157). Since Boole had already laid out a complete logical foundation for probability, and Boole's target was Laplace, Wilson is correct about Keynes, but has erred with regard to Boole, who is not mentioned in his first review. It is only in Wilson's second review in 1934, after Wilson had had the time to digest Part II of Keynes (1921, 1973), that Wilson was finally able to see what it was that Keynes's position was.

Wilson corrected these omissions in his second, disguised review of Keynes (1921, 1973) in Wilson (1934). By then it was clear to Wilson what the Keynes-Boole connection was. It is unfortunate that this second review was never read, but that was Wilson's intention—he sought to make sure that no one else would grasp the Boole-Keynes connection, due to his great envy and jealousy of Keynes. Wilson missed the entire point of both Boole (1854) and Keynes (1921, 1973; 1973), which was that real world decision making usually requires inexact and imprecise probability carried out under conditions of Boolean uncertainty. Of course, so did all other academicians in the 20th and 21st centuries.

There is no citation or mention made of Boole or the Keynes -Boole connection in any of the five centenaries in 2021 that were celebrating the publication of both Keynes's and Knight's 1921 books in the *Cambridge Journal of Economics*, *Review of Political Economy*, *Journal of the History of Economic Thought*, *History of Economic Ideas*, or by the *Alan Turing Institute*.

3. Discussion I. Boolean Uncertainty

The necessary and sufficient condition for the existence of uncertainty (partial ignorance and partial knowledge) is non additivity. A complete order is defined and required to calculate additive, precise, numerical probability, while a partial order is required to estimate non additive, imprecise and non-numerical probabilities. The partial order leads directly to uncertainty, while a complete order leads to risk.

Boole's attack on the purely mathematical conceptualization of additive probability rejects the claim that all probability calculations will always result in a precise answer. The assumption of precision means that there can never be any decision situation where there is any missing or unavailable information, data, evidence or knowledge:

"Are we, however, justified in assigning to a and c particular values [author's note - Boole's technique specifies that the a and c values represent unknowns in the a priori probability estimates. If a decision maker is unable to calculate them in the future, then the a posteriori probability is "indeterminate "(uncertain)]? *I am strongly disposed to think that we are not.* The question is of less importance

in the special instance than in its ulterior bearings. In the applications received of the theory of probabilities, arbitrary constants do not explicitly appear; but in the above, and in many other instances sanctioned by the highest authorities, some virtual determination of them has been attempted. And this circumstance has given to the results of the theory, especially in reference to questions of causation, a character of definite precision, which, while on the one hand it has seemed to exalt the dominion and extend the province of numbers, even beyond the measure of their ancient claim to rule the world; on the other hand has called forth vigorous protests against their intrusion into realms in which conjecture is the only basis of inference. *The very fact of the appearance of arbitrary constants in the solutions of problems like the above, treated by the method of this work, seems to imply that a definite solution is impossible, and to mark the point where inquiry ought to stop. We possess indeed the means of interpreting those constants, but the experience which is thus indicated is as much beyond our reach as the experience which would preclude the necessity of any attempt at solution whatever.*" (Boole 1854, 368; italics added).

Boole's final summary above is very clear that the usual case facing a decision maker is missing or unavailable data in the real world, both a priori and a posteriori, and not situations where all possible outcomes are known in advance:

"26. These results only illustrate the fact that when the defect of data is supplied by hypothesis, the solutions will, in general, vary with the nature of the hypotheses assumed; so that the question still remains, only more definite in form, whether the principles of the theory of probabilities serve to guide us in the election of such hypotheses. I have already expressed my conviction that they do not - a conviction strengthened by other reasons than those above stated. Thus, a definite solution of a problem having been found by the method of this work, an equally definite solution is sometimes attainable by the same method when one of the data, suppose Prob. $x = p_1$ is omitted. But I have not been able to discover any mode of deducing the second solution from the first by integration, with respect to p supposed variable within limits determined by Chap. XIX. This deduction would, however, I conceive, be possible, were the principle adverted to in Art. 23 valid. Still *it is with diffidence that I express my dissent on these points from*

mathematicians generally, and more especially from one who, of English writers, has most fully entered into the spirit and the methods of Laplace; and I venture to hope, that a question, second to none other in the Theory of Probabilities in importance, will receive the careful attention which it deserves." (Boole 1854, 375; italics added).

Note that Boole is criticizing Laplace above in the same manner as Keynes did later, but not as harshly. Boole's uncertainty approach, that it is usually going to be the case that the final answers are going to turn out to be indefinite, can be understood simply by reading the last six pages at the end of chapter XX of Boole (1854) alone. This does not require that the reader has ever actually studied/mastered any of the very demanding material that is involved in the study of Boole's technical approach in chapters XVI to XXII of Boole (1854). The question that still needs to be answered is why is it the case in 2025 that there are practically no academicians who have any knowledge of Boole's creation of an imprecise, logical theory of probability 171 years ago, which was long before Keynes put forth his improved version of Boole's original theory of logical probability in 1921?

I will repeat Boole's severe criticism of the Bernoulli-Laplace Principle of Non-sufficient reason, as it also represents a very severe criticism of F P Ramsey's assertion (1922, 1926, 1931) that all probabilities MUST be precise and additive [see 1-2 for the errors made by Ramsey in his discussions of Keynes]:

"The most usual mode of endeavouring to evade the necessary arbitrariness of the solution of problems in the theory of probabilities which rest upon insufficient data, is to assign to some element whose real probability is unknown all possible degrees of probability; to suppose that these degrees of probability are themselves equally probable; ... It has been said, that the principle involved in the above and in similar applications is that of the equal distribution of our knowledge, or rather of our ignorance—the assigning to different states of things of which we know nothing, and upon the very ground that we know nothing, equal degrees of probability. I apprehend, however, that this is an arbitrary method of procedure." (Boole 1854, 369-370; italics added).

Ramsey's entire theory of subjective probability in (1922, 1926, 1931) is an endeavor on his part

"...to evade the necessary arbitrariness of the solution of problems in the theory of probabilities which rest upon insufficient data..." (Boole 1854, p.369).

by pretending that there are no such problems that actually have insufficient data.

It is easy to see that Keynes's Evidential Weight of the Argument, V , in Keynes (1921, 1973; 1973) is a technical way of being able to deal exactly with those problems in decision making that have insufficient data while circumventing the difficult interval approach to probability, so that $V(a/h)=w$, where $0 < w < 1$, allows one to estimate a decision weight answer that is numerical, while also incorporating BOTH risk and uncertainty. Uncertainty for Keynes in Keynes (1936) is carefully discussed on pp. 148-153 of Keynes (1936). Uncertainty is defined as an inverse function of $V = w$, so that problems impacted by the confidence one has in the data, discussed by Boole on pp. 381, 398, and 403 of Boole (1854), usually result from decision making situations whenever the decision maker is faced with "insufficient data."

We can now incorporate Boole's emphasis on the existence of insufficient data with our original discussion concerning the generality of his approach in economics. All neoclassical schools of thought operationalize the concept of precise probability as being additive, which means that there is never any cases of insufficient data. This means that there can never be any uncertainty as there is never any missing and/or unavailable data. Keynesian uncertainty, built on Boolean uncertainty, states that there is usually cases of insufficient data in many decision situations being faced by real world decision makers.

4. Discussion II. Boole on the Mental and Emotional Aspects of Expectations Formation

Boole, like Keynes, never made the mistake made by all neoclassical economists, which was to have asserted, following Bentham, that expectations that are rational are the result only of purely mathematical and statistical calculations:

"Though our expectation of an event grows stronger with the increase of the ratio of the number of the known cases favourable to its occurrence to the whole number of equally possible cases, favourable or unfavourable, it would be unphilosophical to affirm that the strength of that expectation, viewed as an emotion of the mind, is capable of being referred to any numerical standard. The man of sanguine temperament builds high hopes where the timid despair, and the irresolute are lost in doubt. As subjects of scientific inquiry, there is some analogy between opinion and sensation. The thermometer and the carefully prepared photographic plate indicate, not the intensity of the sensations of heat and light, but

certain physical circumstances which accompany the production of those sensations. So also, the theory of probabilities contemplates the numerical measure of the circumstances upon which expectation is founded; and this object embraces the whole range of its legitimate applications. The rules which we employ in life-assurance, and in the other statistical applications of the theory of probabilities, *are altogether independent of the mental phænomena of expectation. They are founded upon the assumption that the future will bear a resemblance to the past; that under the same circumstances the same event will tend to recur with a definite numerical frequency; not upon any attempt to submit to calculation the strength of human hopes and fears.*" (Boole 1854, pp.244-245; italics added)

It is clear that Boole is talking about the same kind of variable that Keynes labelled as 'animal spirits' in Keynes (1936) on pp. 161-163, a variable that Keynes had omitted from discussion in Keynes (1921, 1973; 1973).

Boole's understanding of the intermingling of the objective, mathematical expectation estimations, along with the subjective nature of the mental and emotional aspects of a decision about what to do in the future, given the present data and the particular disposition that one has to act, is made even clearer later in LT:

"Let it be granted that there exists such a feeling as expectation, a feeling of which the object is the occurrence of events, and which admits of differing degrees of intensity. Let it also be granted *that this feeling of expectation accompanies our knowledge of the circumstances under which events are produced, and that it varies with the degree and kind of that knowledge. Then, without assuming, or tacitly implying, that the intensity of the feeling of expectation, viewed as a mental emotion, admits of precise numerical measurement, it is perfectly legitimate to inquire into the possibility of a mode of numerical estimation which shall, at least, satisfy these following conditions, viz., that the numerical value which it assigns shall increase when the known circumstances of an event are felt to justify a stronger expectation, shall diminish when they demand a weaker expectation, and shall remain constant when they obviously require an equal degree of expectation.*" (Boole 1854, p.272; italics added).

Thus, the correct mathematical treatment of expectations requires Keynes'(Boole's) 'animal spirits' characterization as being a supplemental and supporting aspect of the mathematical handling of expectations, which necessitates 'reasonable' calculation in the form of imprecise probability estimates. The use of strict or exact mathematical expectation calculations is merely a version of J. Bentham's calculation of Maximum Utility with exact and precise mathematical probabilities and utilities, which is what neoclassical economists mean by economic analysis. Keynes correctly called this kind of rationality "pseudo rational".

3. Discussion III. Boole's Criticisms of the Laplacian Approach in LT are Very Similar to Keynes's Heavy Criticisms of the Laplacian Approach in the TP

It is interesting to note Boole's criticisms of what Keynes would later identify as the Laplacian approach to probability in his TP. Keynes was roundly criticized for his correct criticisms of precise probability assessment. No one has ever published a critique of Boole for levelling what is essentially the same critique as made by Keynes, but without the fervor demonstrated by Keynes. Apparently, no economist or philosopher has read Boole's book since 1854. Thus, just as Hishiyama pointed out in 1969, that economists and philosophers did not read Keynes (1921/1973; 1973). Economists and philosophers have not read (Boole 1854). This type of severe and extreme ignorance can only lead to the acceptance of a non (anti?) - scientific basis for economics and philosophy as regards the evaluation of Keynes's work, as of the year 2025.

Conclusions

Keynes learned about Boole's contributions from both his father, John Neville Keynes, and William Ernest Johnson, who was also an advocate of logical probability and of his 'worth of the evidence' analysis, which was a precursor of Keynes's evidential weight of the argument analysis. Keynes thus based (1921/1973; 1973) completely on Boole's

- formal, mathematical, symbolic, relational, propositional logic
- interval valued probability (imprecise probability), as opposed to precise numerical probability
- analysis of propositions about outcomes of events, as opposed to the outcomes or events themselves
- opposition to the general use of the Principle of Indifference
- requirement that a logical analysis must always precede any type of mathematical analysis
- problem X, which is the foundation for Keynes's mathematical theory of induction in Part III of the TP

- understanding of the nexus between mathematical expectations analysis and the individual psychological impact upon the decision makers' expectations of his emotions, feelings, and mental and psychic states

- discussions of the limitations of mathematical analysis
- mention of the role of confidence in estimating expectations as depending on the strength of the data independent of any probability analysis

- discussion of the role of perception and Intuition in the application of Boolean logic
- objective, logical, probability relation that holds between related propositions and not Ramsey's unrelated propositions

Keynes added to Boole's logical theory of probability in his Keynes (1921/1973; 1973) by rigorously expanding the Boolean, relational, propositional logic to

- incorporate Keynes's theory of groups in chapters X and XI of the Keynes (1921/1973; 1973) before any discussion is devoted to the mathematical definitions and axioms of the calculus of pure mathematical probability, which take place in chapters XII to XIV of Keynes (1921/1973; 1973). Chapters XV to XVII of Part II of Keynes (1921/1973; 1973) further develop Boole's original interval valued approach to probability

- expand the logical analysis of probability to incorporate Keynes's new logical relation, the evidential weight of the argument, in chapters VI and XXVI of Keynes (1921/1973; 1973).

- create the world's first decision weight approach, the conventional coefficient of weight and risk, in Chapter XXVI, pp.312-315, p.315 ft.2

- specify a Least Risk (Safety -First analysis). The special case was analyzed on page 315 and p.315, ft.1 of Keynes (1921/1973; 1973) and the general case was analyzed on pp.353-358 of Keynes (1921/1973; 1973).

Thus, Keynes advanced the theory in Boole (1854) of imprecise theory using his logical probability in Keynes (1921/1973; 1973) and used this approach as the foundation for both his *A Treatise on Money* (1931, Vol.1, chapters 6, 7 and 8) and Keynes (1936), chapters 4,12 and 17. Given that E. Borel, F. Y. Edgeworth and E. B. Wilson, all world class mathematicians, admitted that they could not follow Keynes in Part II of Keynes (1936), it is not surprising that there were no academicians, economists or philosophers in the 20th or 21st century who were able to figure out the nature of Keynes's many contributions in Keynes (1921/1973; 1973). It was Hishiyama (1969), however, who first pointed out the severe problem facing economists, who were trying to assess the role of the connections between Keynes's *A Treatise on Money* and Keynes (1936) without having first read Keynes (1921/1973; 1973) - a blind spot had resulted in their analysis, a blind spot that still exists today.

Keynes (1921/1973; 1973) is built on the shoulders of an intellectual giant, G. Boole. The fact that his major contributions to decision making under risk and uncertainty are still unknown some 170 years after the publication of Boole (1854) is incomprehensible and a scandal that merits investigations into the existing publication structures existing in academia.

It is clear that, from Keynes's perspective, there was no one else before him who had made any advance technically in constructing a general theory of decision making that had the goal of making imprecision the general case and precision a special case:

"Several modern writers have made some attempt at a symbolic treatment of Probability. But with the exception of Boole, whose methods I have discussed in detail in Chapters XV., XVI., and XVII., no one has worked out anything very elaborate." (Keynes 1921, 155)

The publication of a number of articles' (Gerrard 2022, 2023a, 2023b, 2023c), as well as the recent publication in 2023 of Clarke (2023) by Cambridge University Press, containing an entire chapter supposedly detailing Keynes's acceptance of Ramsey's empty diatribes against logical theories of probability, demonstrates severe and ongoing ignorance. The over 100 years of ignorance about the imprecise, logical approach to probability contained in Keynes (1921/1973; 1973) and the 170 years of ignorance of the imprecise, logical probability approach in Boole (1854) could not have happened in physics, electronics, engineering, chemistry, or biology. The failure to correct errors in the economics and philosophy literature simply means that economics and philosophy are not sciences, not arts, not artistic and not scientific. Fields where errors are not corrected over time but are amplified and magnified in the ongoing literature over hundreds of years, can't possibly be viewed as being scientific if one is using the standard philosophy of science definition, which is that real sciences correct their errors over time.

Therefore, the claim that economics and philosophy are scientific, while major errors continue to go on as time goes by unabated, means that some other criteria is being used to satisfy the claims of scientific creditability. Apparently, the criteria being applied is that these fields use a lot of mathematics and statistics notation.

The ignorance of Boole's contributions are difficult to understand as, starting in 1855, Boole switched his approach to modeling uncertainty to the technique devised by Henry Wilbraham. Apparently, Boole's use of Wilbraham was overlooked, leaving readers with the a nearly impossible task of mastering (Boole 1854, chapters XVI to XXII). However, this does not explain why the much more readable chapters of (Boole 1854, I to XV) were also usually ignored.

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Declaration of Competing Interest

The author is a member of Editorial Board and was not involved in the editorial review or the decision to publish this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

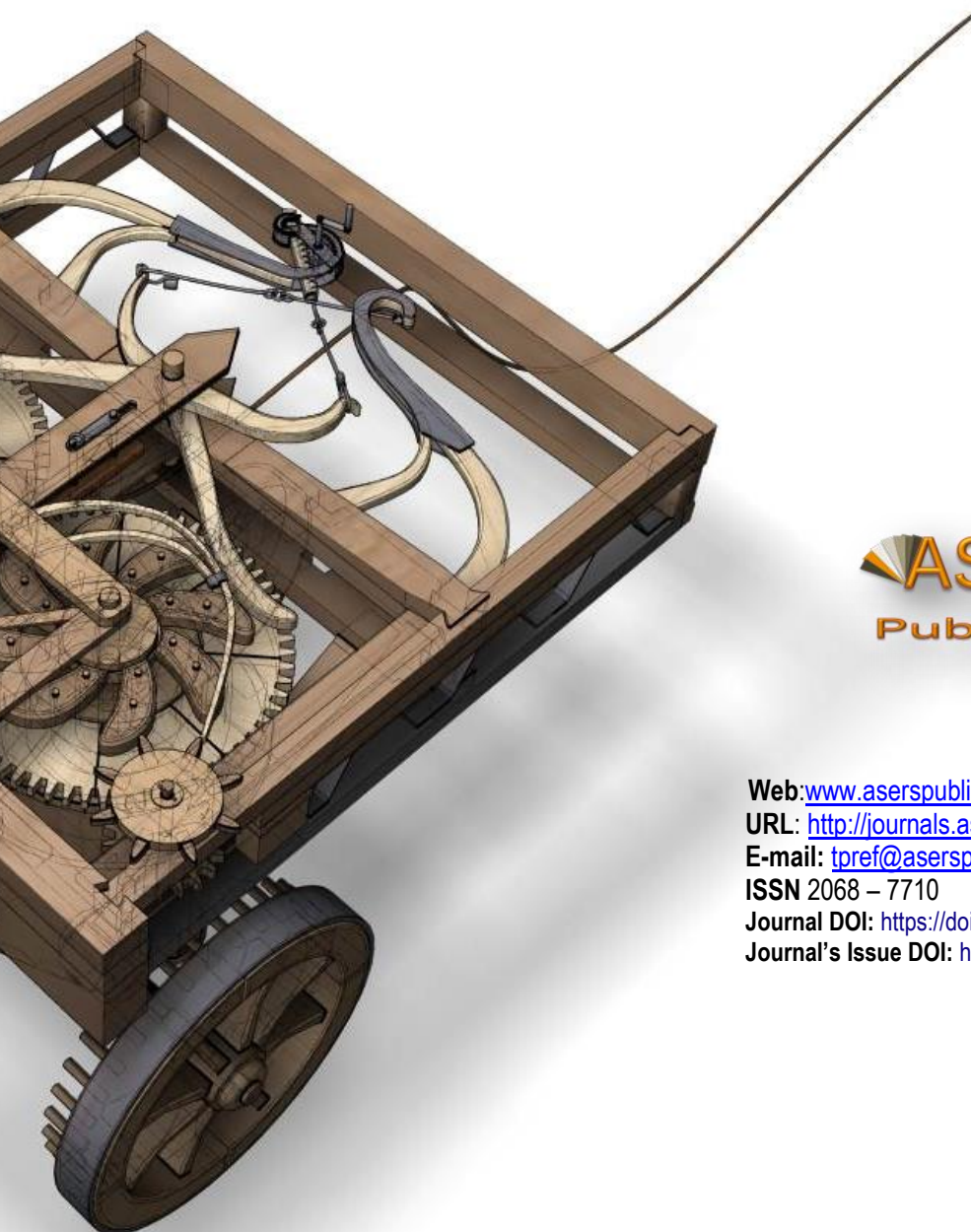
The author declares that he has not used generative AI and AI-assisted technologies during the preparation of this work.

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