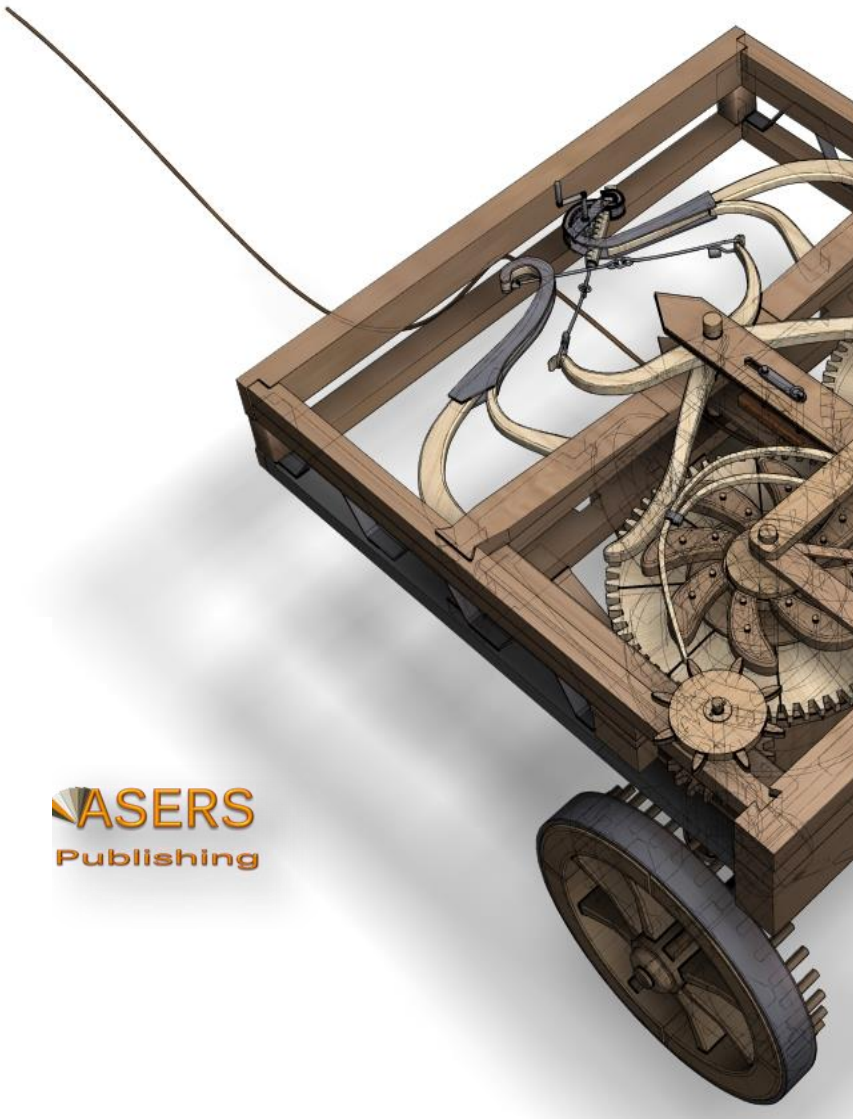
Theoretical and Practical Research in Economic Fields



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G. Boole, Not J. M. Keynes, Is the Founder of the Logical Approach to Probability

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Abstract: *A fundamental and basic error committed by all economists and philosophers doing work on Keynes is their failure to realize that the original, logical theory of probability, with the consequent emphasis placed on relational, propositional logic, imprecise probability and interval valued approaches to decision making, was developed by George Boole and not by J. M. Keynes.*

All one needs to do is read chapters I, II and X to XVII of Keynes's 1921 A Treatise on Probability and compare Keynes's chapters with chapters I, XI, XII and XVI to XXI of Boole's The Laws of Thought. A shorter route to this conclusion is to skip all but chapter I of Boole and compare it with chapter I of Keynes. Why no social scientist, behavioral scientist, economist, or philosopher has been able to do this simple task is a question that needs to be investigated by psychologists and psychiatrists looking for problems related to cognitive dissonance.

A careful reader of chapters I and II of Keynes's A Treatise on Probability will soon realize that Keynes is talking explicitly about Boole's logical, objective, probability relation. This relation has absolutely nothing to do with Plato's theory of forms. How do we come to know this relationship? Boole states that we come to know this relationship through both observation (empirical) and reflection (intuition or perception).

This paper shows that there is a deep Boole-Keynes connection that has been overlooked in the literature on Keynes. Keynes built his logical theory of probability on Boole. One can extend Hishiyama's 1969 conjecture, about Keynes's A Treatise on Probability not having been read by any economist, to also conclude that Boole's The Laws of Thought was not read by any other economist except Keynes.

Keywords: Boolean (Keynesian) objective; logical relations; Platonic objective, logical relations; relational; propositional logic; common discourse logic; Boole; Keynes; Plato.

JEL Classification: B12; B14; B16; B18; B20; B22.

Introduction

The paper will be organized in the following manner. Section One, the Literature Review, will examine the work of George Boole. Section Two, Method (Part I), will examine the writings of an economist., R. M. O'Donnell (1989, 1990, 2004a, 2004b) who has completely overlooked Boole's (1854) contribution. We will examine O'Donnell's claims about this question of Boole's priority over Keynes concerning the credit for the founding of the logical theory of probability. Section Two, Method (Part II) will examine the writings of a philosopher, D. Rowbottom (2008, 2018) on this same issue. Section Three, Research Results, covers the issue of why Boole's and Keynes's works were not covered by economists and philosophers. Section Four, Discussions, will reiterate Hishiyama's 1969 conclusion, based on his assessment and evaluation of the issue of the relevance of Keynes's new logic of uncertainty (1921, 1973) for his later writings, such as the *General Theory*, that Keynes's *A Treatise on Probability* had never been read. The Conclusion will end the paper.

1. Literature Review: Boole's Laws of Thought

In 1854, Boole demonstrated that there was a dual nature concerning the concept of probability involving both mathematics and logic. Boole was the first to notice that the standard mathematical laws of the calculus of probability (disjunction, conjunction, complementarity) were directly related to the logical operators in his relational, propositional logic- "or" (union of probabilities), "and" (joint probability) and "not" (complementarity). Boole substituted propositions about events or outcomes for the events or outcomes themselves. He carefully discussed the role of premises, conclusions, arguments, true and false propositions, primary and secondary propositions, as well as direct and indirect knowledge. This then led in chapters XVI to XXI to his application of his relational, propositional, formal logic of probability, the specification of probability as being a logical relation connecting premises containing evidence to conclusions using conditional if-then statements and bi-conditional statements, using if -and -only -if. Boole also assigned priority in his study of probability as involving dual mathematical and logical conceptualizations, but with logical considerations coming first and mathematics (quantification by numbers) being relegated to coming second:

"The general doctrine and method of Logic above explained form also the basis of a theory and corresponding method of Probabilities. Accordingly, the development of such a theory and method, upon the above principles, will constitute a distinct object of the present treatise." (Boole 1854, p.8).

Boole's assessment above leads him to the following conclusion:

"The ground of this necessity of a prior method in Logic, as the basis of a theory of Probabilities, may be stated in a few words. Before we can determine the mode in which the expected frequency of occurrence of a particular event is dependent upon the known frequency of occurrence of any other events, we must be acquainted with the mutual dependence of the events themselves.
Speaking technically, we must be able to express the event whose probability is sought, as a function of the events whose probabilities are given. Now this explicit determination belongs in all instances to the department of Logic. Probability, however, in its mathematical acceptance, admits of numerical measurement.
Hence the subject of Probabilities belongs equally to the science of Number and to that of Logic. In recognizing the co-ordinate existence of both these elements, the present treatise differs from all previous ones; and as this difference not only affects the question of the possibility of the solution of problems in a large number of instances, but also introduces new and important elements into the solutions obtained…" (Boole, p.13)

This results in the following conclusion:

"In the first place it is always possible, by the preliminary method of the Calculus of Logic, to express the event whose probability is sought as a logical function of the events whose probabilities are given." (Boole, p.15)

This then leads to Boole's specification of a logical relation of probability involving "…reflection" on the part of the decision maker regarding the nature of the connection of the premises to the conclusion:

"General reasoning would verify this conclusion; but general reasoning would not usually avail to disentangle the complicated web events and circumstances from which the solution above described must be evolved. The attainment of this object constitutes the first step towards the complete solution of the question I proposed. It is to be noted that thus far the process of solution is logical, i. e. conducted by symbols of logical significance, and resulting in an equation interpretable into a proposition. Let this result be termed the final logical equation.

The second step of the process deserves attentive remark. From the final logical equation to which the previous step has conducted us, are deduced, by inspection, a series of algebraic equations implicitly involving the complete solution of the problem proposed. Of the mode in which this transition is effected let it suffice to say, that there exists a definite relation between the laws by which the probabilities of events are expressed as algebraic functions of the probabilities of other events upon which they depend, and the laws by which the logical connexion of the events is itself expressed. This relation, like the other coincidences of formal law which have been referred to, is not founded upon hypothesis, but is made known to us by observation (I.4), and reflection." (Boole, p.16).

We can extend our discussion about Keynes's book never having been read to reach the same conclusion with regards to Boole's *The Laws of Thought*. Boole's 1854 book has never been read by any social scientist, economist or philosopher involved in the study of Keynes's *A Treatise on Probability*. That Keynes was

using Boole's formal, symbolic, mathematical, relational, propositional logic in the *A Treatise on Probability* has still not been recognized by any 20th or 21st century economist or philosopher.

Reading Boole allows a reader to realize that Keynes' s logical, objective, probability relations are identical to Boole's logical, objective, probability relations. There are thus no such things as Platonic logical probability relations in either Boole's The Laws of Thought or Keynes's A Treatise on Probability. The universal misbelief that Keynes was relying on Plato, who is never mentioned or cited by Keynes anywhere in the A Treatise on Probability, was due to the failure of academicians to understand that Keynes's Boolean, relational, propositional logic is a formal, mathematical, symbolic logic that would take a great deal of substantial effort to understand on their part. No economist or philosopher made the required effort.

The Carabelli - Dow (Carabelli, 1988 p. 23; Carabelli, 2003; Dow, 2012, p.2) conclusion claims that Keynes's logic was only a common sense, discourse logic written out in the English language. There exists no such logic anywhere in Keynes 's *A Treatise on Probability*, just as Ramsey's Axiom I (Ramsey 1922, p.3; Ramsey 1928), upon which Ramsey claimed that Keynes's logical approach was based, appears nowhere on any pages in Keynes's A Treatise on Probability.

2. Method (Part I) - on R. O'Donnell 's Erroneous Attribution of Boole's Achievements to Keynes

Consider the following statement made by O'Donnell (1989):

"The main concern of the TP, however, was logic rather than epistemology. Its basic objective was to solve the puzzle of rational but non-conclusive argument - to analyze and justify the innumerable arguments in science, daily life and elsewhere which are believed to be rational in some sense, but which are not deductively conclusive. Keynes's solution was to bring this family of argument under the sway of logic by making the theory of probability synonymous with the theory of logic. Probability then became the general theory of logic, dealing with the logical relationships between virtually any pair of propositions, and containing the traditional deductive logic as a special case. The natural vehicle for this project was a logical conception of probability in which probability was concerned with logical relations between propositions, the typical case being that of an argument in which the premisses lend only partial support to the conclusion. Keynes referred to these relations of partial support or entailment between propositions as probability-relations and made the additional claim that such relations expressed the degrees of rational belief that individuals were warranted in placing in the conclusions of such arguments.

Nevertheless, epistemology was indispensable to Keynes's logical project for it was necessary to explain how individuals came to know these probability-relations and degrees of rational belief. But although required to take up an epistemological position, Keynes displayed markedly different attitudes to the two disciplines. While generally confident on matters of logic, he expressed hesitancy in regard to epistemology, viewing it as a 'disordered and undeveloped' area of philosophy (292)." (O'Donnell 1989, 334-335).

There are two errors that need to be corrected here. The first error comes from O'Donnell's acceptance of Ramsey's false definitions, contained in his reviews of Keynes's logical theory of probability in 1922 and 1926, as being applicable" to any two propositions." (Ramsey 1922, 3; Ramsey 1928, 27). This is, of course, Ramsey's non -existent Axiom I, which Ramsey claimed Keynes's logical theory of probability was based on and which he had shown was false. O'Donnell thus accepts an Axiom I that existed only in Ramsey's imagination.

O'Donnell states that Keynes's theory was about "…dealing with the logical relationships between virtually any pair of propositions…" (O'Donnell 1990, 334; see O'Donnell 1989, 23, 34, and 40 for similar errors).

Keynes's theory deals with those sets of propositions which are related/relevant/similar to other sets of propositions only. It is not restricted to pairs of propositions.

The second error made by O'Donnell is O'Donnell's claim that Keynes was "… making the theory of probability synonymous with the theory of logic. "They are not synonymous since logic forms the foundation for Keynes's theory of probability. Logic came first and probability came second for both Boole and Keynes as regards probability.

The rest of O'Donnell's statement about what Keynes accomplished is, in fact, an excellent statement summarizing what George Boole first accomplished in 1854, 67 years before Keynes's book was published. Thus, where ever Keynes's name appears in O'Donnell's discussion, it must be replaced with Boole's name. O'Donnell has never mentioned G. Boole in any of his work that commenced in 1978. Neither has any other of Misak's (2020) so called" Keynes scholars." (See Bateman 1987, 1989, 1990, 1992, 2016, 2021, Blackburn 2021; Carabelli 1988, 2003; Dow 2012; Davis 1994; Gerrard 2023; Good 1962; Hacking 1980; Mellor 1983; Monk 1991; Runde 1994; Russell 1922; Skidelsky 1992; Wheeler 2012; Wilson 1923; Zabell 1991; Zabell 2005).

The question then becomes what was it that Keynes did? What Keynes did was to advance the Boolean research program much further than where it was at the time of Boole's premature death at the age of 49. After Keynes, Hailperin (1965) advanced this research program further in 1986. That is where the current state of Keynes's logical theory currently resides.

2. Method (Part II) - on D. Rowbottom 's Erroneous Attribution of Boole's Achievements to Keynes

Consider Rowbottom's (2008, 2018) assessment of the logical theory of probability in 2008 and 2018 below. First, consider Rowbottom's belief that Keynes was "…the architect of the logical interpretation, used 'logical relations'" (Rowbottom 2018, 419). This is simply erroneous. Boole, not Keynes, was the architect of the logical theory of probability. It was Boole, not Keynes, who developed the concept of logical relations. Keynes simply applied and then further developed Boole's original system.

Second, consider what Rowbottom's severe and serious misinterpretation of what is implied by the use of the Boolean-Keynesian concept of logical relations:

"According to Keynes (1921), probabilities are objective in a Platonic sense, and consist of relations that subsist between propositions {qua abstract entities); …Yet one is supposed to be capable of grasping some of these relations, at least, by intuition alone…So Keynes has the view that 'degrees of rational belief map onto 'objective and logical relations', but this is not an identity claim. On the contrary, there are relations between non-spatiotemporal entities (namely propositions) which are 'out there', and which one is obliged to 'spot', so to speak, if one is to arrive at rational judgement." (Rowbottom 2008, 336-337).

This assessment has nothing to do with any of Keynes's analysis of rational judgment or with Boole's logical relations that connect the premises and conclusions of an argument. Rowbottom's failure, as is the case with all other writers on Keynes's logical theory of probability for over 100 years, to grasp the Boole-Keynes connection, led him to substitute the metaphysical and nebulous 'platonic relations' of Plato, Platonism, and Neo-Platonism among entities for Boole's relational, propositional, formal, symbolic logic, which is what Keynes used throughout the A *Treatise on Probability* (1921, TP). Boole's *The Laws of Thought*, and not Plato, Moore, Locke, Leibnitz, Von Kries, Wittgenstein, Russell, etc., is the major foundation for Keynes's logical theory of probability.

Until this is recognized, there is no chance of any future progress being made in the further development and application of the Boole-Keynes system of decision making under uncertainty for the rest of the 21st century.

3. Research Results

Academicians are unable to make correct assessments of Keynes's work because they (a) have not read Keynes's TP (Hishiyama 1969) and /or (b) they lack any understanding of Keynes's reliance throughout the TP on the original work done by [8] through his relational, propositional logic. I can find no careful and researched discussion of the Boole - Keynes logical connection except for (Hailperin 1965 and Brady 2004a, 2004b, 2022, 2012) in the 20th and 21st centuries.

The main reason for the failure of the economics and philosophy professions to grasp Keynes's TP is the severe error of assuming that Ramsey had proven Keynes's TP to be logically flawed because it was based on an Axiom I that Ramsey supposedly proved to be false. In fact, there is no such axiom anywhere in Keynes's *A Treatise on Probability* or anywhere in any other publication of Keynes. In fact, Ramsey's reviews of Keynes are full of so many errors that they must be viewed as the lack of any substantial knowledge on Ramsey's part. Ramsey, an 18-year-old university student just out of high school, never understood (a) what Boole's relational, propositional logic consisted of or how Keynes was applying it continuously throughout his book, and (b) what the required logical relation, existing between a premise and a conclusion, entailed. Ramsey's work is simply not a scholarly contribution to the literature on Keynes and the logical theory of probability. Ramsey fails to provide even one reason for rejecting Keynes's logical theory of probability in either of his two reviews.

4. Discussions

This state of affairs has been going on now for over 100 years. It is time for this intellectual fiasco to be ended. Keynes did not accept Ramsey's critiques because of the immense number of errors contained in them. For instance, Keynes is 180 degrees in the opposite direction from Ramsey concerning the use of mathematical expectations to base decisions on. Keynes emphasized degrees of rational belief. Ramsey emphasized degrees of belief (actual beliefs). There simply is no agreement possible between the two in the same way that there was no agreement possible between J. Tinbergen and Keynes. Keynes was committed to the use of imprecise probability both in theory and application. Ramsey and Tinbergen are committed to different theories of precise probability (subjective and frequentist, respectively) both in theory and application. Neither Ramsey nor

Tinbergen had the slightest inkling that Keynes's position was one of imprecise probability expressed through the method of interval valued probability that was based on the original work of G. Boole. This same situation exists today as regards C. Misak's "Keynes scholars". None of them has any inkling that Keynes's position follows directly from Boole's original, foundational thought that involves a relational, propositional logic that is then combined with an interval valued approach to probability. Boole provided Keynes with a method of logical analysis and a way of operationally quantifying decision situations of partial information or knowledge and partial ignorance, which was Keynes's definition of uncertainty. Keynes basically based Part II of his TP on chapters XVI-XXI of Boole's *The Laws of Thought*. This Boolean foundation then appears in chapters X to XVII, XX and XXII of Keynes's A *Treatise on Probability*.

Conclusions

Keynes's rational degrees of belief are not mysterious or mystical, Platonic entities, concepts, forms or relations that have to be intuited in order to make a probabilistic analysis or estimate probabilities. They are no different than Boole's logical, probability relations, relations that must exist between related propositions for any conclusion to be derived.

Thus, Keynes's rational degrees of belief follow directly from the application by Keynes of G. Boole's relational, propositional logic, which requires that there be a logical connection between the premises and conclusions provided by a logical relation. Boole's formal, symbolic, mathematical logic is the foundation for Keynes's work in Keynes (1921, 1973).

Of course, Keynes's ethical outlook and ethical foundation is based on a Platonic-Aristotelian mixture that is based directly on Moore's version of Virtue Ethics .Moore presented his version of Virtue ethics in his 1903 *Principia Ethica*, of which chapter six attracted Keynes's interest .However, nowhere in Keynes (1921, 1973) does Keynes mention Plato, Platonism, Platonic, metaphysical relations, probabilities as being Platonic entities that have to be intuited in order to understand their essence, Plato's theory of Forms, or Neo Platonism.

It was the severely erroneous claims of F P Ramsey, where Keynes's Boolean, logical relations between the premises and conclusions were characterized by Ramsey as being "…Mr. Keynes's mysterious logical relations", that has led practically all economists and philosopher doing work on Keynes's logical theory of probability astray. Ramsey simply had no idea what he was talking about. Attempting to find some type of positive reaction on Keynes's part to Ramsey's many erroneous characterizations of Keynes's work can only occur because the so-called Keynes scholars read into Keynes's work assessments that are nonexistent, such as supporting Ramsey's claims about an "…Axiom I…" that never existed anywhere in any of Keynes's work on probability except in Ramsey's mind.

No progress can be made in Keynes studies until it is recognized that Keynes's theory is one of imprecise probability, which was based on Boole's original, imprecise interval valued approach to probability, and has nothing to do with any notion of ordinal probability.

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Declaration of Competing Interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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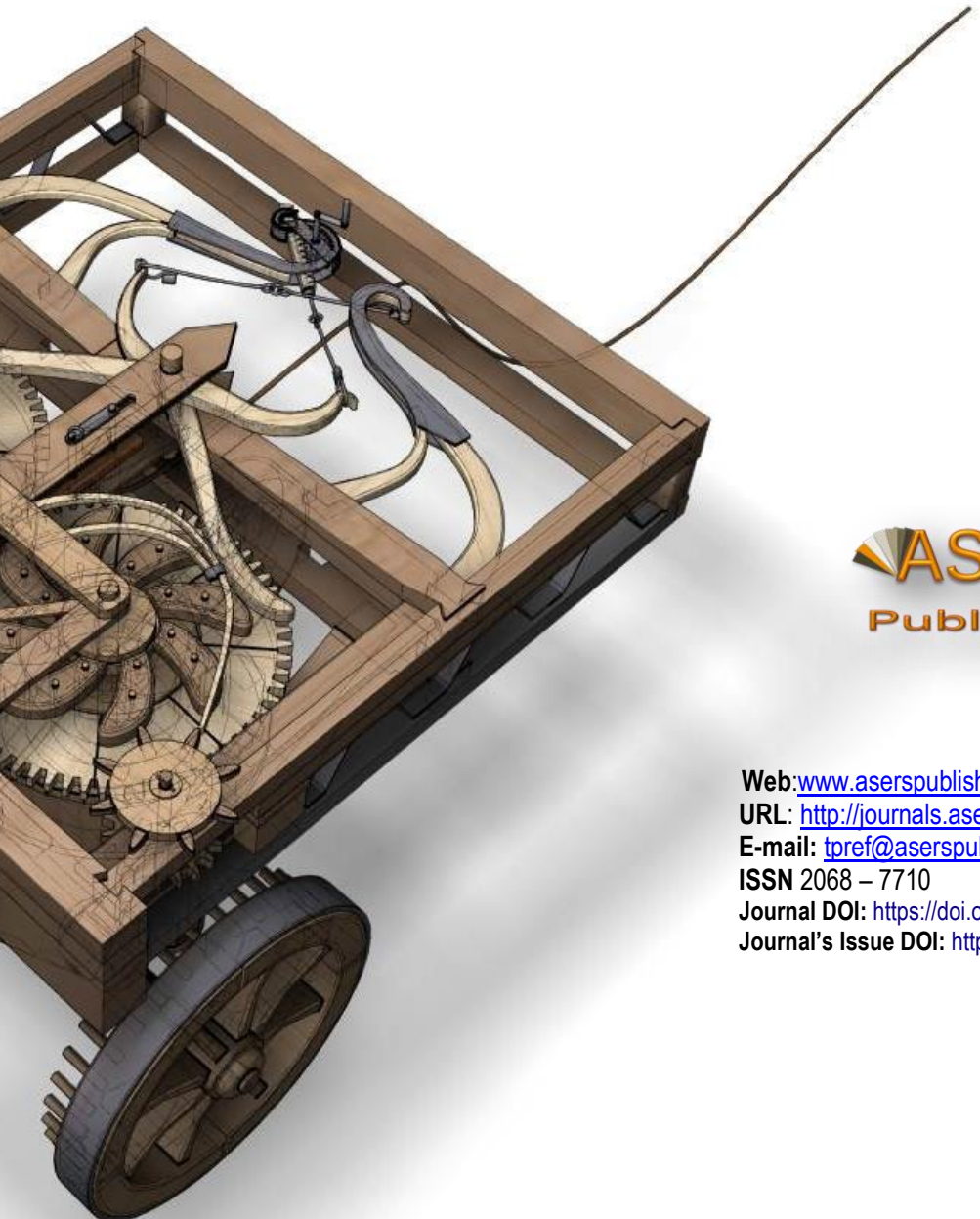

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