INTERNATIONAL JOURNAL OF RESEARCH IN ECONOMICS AND FINANCE, 2025, Vol. 2, No. 9, 125-146. https://doi.org/10.71420/ijref.v2i9.166

Knightian and Keynesian Uncertainty: Eclipsed or Resurgent?

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Abstract. Uncertainty, as defined by Knight and Keynes in the 1920s, is now an essential key to understanding large-scale unpredictable events, such as 2020's pandemic. The inability of predictive models to anticipate the scope and impact of this unprecedented crisis has highlighted the relevance of a century-old theory that has long been marginalized in favor of predictive mathematical formalism. Beyond the economic field, this study offers an extensive and in-depth bibliometric analysis of literature to assess whether Knightian and Keynesian uncertainty remains overshadowed or whether, on the contrary, it is attracting renewed interest considering contemporary context. Using a corpus of 455 multidisciplinary articles from Scopus database from 1977 to 2024, this research uses R-Biblioshiny and VOSviewer software to provide a detailed overview of publication dynamics, key players and collaborative interactions. Through performance and scientific mapping analysis, the results reveal that the subprime crisis and the Covid shock acted as catalysts for a renewed awareness of the risk/uncertainty dichotomy, while highlighting the existence of two paradigms. The first, emerging and with a strong academic impact, tends to reintegrate this uncertainty into operational modelling frameworks, while the second, derived from heterodox economics, remains attached to its irreducible conception.

Keywords: *Knight; Keynes; Uncertainty; Risk; Bibliometrics.*

1. Introduction

For over a century, the conceptual dichotomy between risk and uncertainty, introduced by Frank H. Knight (1921), marked a major turning point in economic decision-making theories. Knight made a radical distinction between risk, which can be reduced to a probabilistic assessment, and uncertainty, which cannot be formally measured/quantified. He states that:

> Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated [...] The essential fact is that 'risk' means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomena depending on which of the two is really present and operating [...] It will appear that a measurable uncertainty, or 'risk' proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all. (Knight, 1921, p. 19)

This position was shared and expanded by John M. Keynes (1921, 1936 & 1937), who presented uncertainty as a major determinant of economic behaviour in an unknown future, particularly in the financial and macroeconomic spheres. In his reflections on uncertainty, he asserts:

> By uncertain knowledge, let me explain, I do not mean merely to distinguish what is known for certain from what is only probable. The game of roulette is not subject, in this sense, to uncertainty [...] The sense in which I am using the term is that in which the prospect of a European war is uncertain, or the price of copper and the rate of interest twenty years hence [...] We simply do not know. (Keynes, 1937, pp. 113–114)

Far from being merely a theoretical stance, this Knightian and Keynesian view of uncertainty has found its most revealing form in contemporary crises, highlighting the limitations and weaknesses of traditional forecasting models.

The global financial crash of 2007–2009 was the catalyst that gave this dichotomy its first empirical legitimacy. It led to an awareness of the extent of uncertainty and sparked interest in the work of our two economists in the face of non-probabilistic events. This crisis highlighted the limitations of economic models in situations of uncertainty (Kay and King, 2020). The tools used by central banks and other financial institutions to make forecasts proved incapable of predicting or explaining the repercussions of a global recession, revealing profound gaps in the understanding of risk and uncertainty (Kay and King, 2020). Many voices have gradually emerged in the scientific community to examine in depth the nature of uncertainty, perceived as one, if not the only, factor driving this crisis (Köhn, 2017). In addition to the terms inherited from our two pioneers - "fundamental", "radical", "true", "genuine", "unmeasurable" or "non-probabilistic" uncertainty - other scholars and theorists have over time proposed alternative expressions such as "irreducible uncertainty" (Lemons, 1998), "deep uncertainty" (Lempert et al., 2003) or "severe uncertainty" (Ben-Haim, 2006), to characterise this unquantifiable uncertainty. All these intellectual initiatives have worked to rehabilitate Knightian and Keynesian uncertainty (K&K uncertainty) in the academic field, calling for a renewed reading of phenomena that have become unpredictable and inevitable through more open, dynamic and contextualised approaches.

Nevertheless, even with such an economic shock, this approach to uncertainty did not withstand the influence and hegemony of the formalist current and was relegated to the background in favour of neoclassical models favouring calculable risk and rational expectations, as evidenced by Hodgson's bibliometric study (2011). The author observed a drastic decline in references to K&K uncertainty in mainstream literature since the 1950s. In a short period of time, the concept of uncertainty was overshadowed by a growing and overwhelming obsession with quantification, modelling and mathematical prediction (Hodgson, 2011).

Furthermore, while the subprime crisis had reignited interest in K&K uncertainty, the global health crisis of 2020 provided an even more striking manifestation of it. Considered the greatest crisis the world has faced since the Second World War (Mohapatra, 2020), the Covid-19 pandemic illustrated this uncertainty with unprecedented force. It has created a climate of uncertainty at all levels, affecting the virological characteristics of SARS-CoV-2, health strategies (testing, vaccines, hospital capacity), immediate and long-term economic impacts, societal transformations (consumer behaviour, business survival) and the sustainability of public policies (Baker et al., 2020). Due to the unpredictability of health and socio-economic issues (Harford, 2020 ; del-Valle et al., 2022), many scientists have found it extremely difficult to anticipate the true extent of the consequences (Holmdahl and Buckee, 2020), revealing with unprecedented clarity the limits of predictive capabilities in the modern era, despite the availability of cutting-edge technologies and advanced expertise. Unable to be captured by traditional forecasting methods (Sleiman et al., 2020), uncertainty has varied considerably, leading to completely unprecedented and unpredictable situations where everything has been uncertain (Silberzahn, 2020). The pandemic created a context in which the scale and simultaneity of the shock gave rise to "extreme" Knightian uncertainty and a constantly changing environment (Okamoto, 2020). However, although this uncertainty has significantly influenced the measures and management policies adopted by decision-makers, it has been paradoxically overshadowed by a claim to predictability and an illusion of control provided by the use of quantitative models (Xu, 2021). Quantitative knowledge, considered attractive (Merry, 2016), continued to be perceived as more objective, direct, transparent and open than qualitative knowledge, promoting decision-making that was deemed more "democratic" (Rottenburg et al., 2015). The use of probability calculations and associated mathematics has fuelled the illusion of transforming the "mysteries" of K&K uncertainty into "puzzles" with calculable solutions (Kay and King, 2020).

In this context, and after more than a decade, the place of K&K uncertainty in academic debate and the thesis of its eclipse, as formulated by Hodgson (2011), deserve to be revisited and updated considering recent global upheavals and advances in data science. Based on a corpus of publications indexed in the Scopus database for the period 1977–2024 (the database's effective and exhaustive time coverage), this study employs an in-depth bibliometric analysis, combining quantitative indicators and scientific output mapping using Biblioshiny and VOSviewer software. The aim is to provide an empirical and interdisciplinary view of the representation of Knight and Keynes' theoretical legacy in academic literature, and thus to answer the following question: does K&K uncertainty remain marginalised in the contemporary academic scene, or are there signs of a resurgence, particularly considering recent crises?

This paper makes three major and original contributions to the literature on radical uncertainty. First, it provides an exhaustive and systematic mapping of the use of concepts related to the risk/uncertainty dichotomy, drawing on all disciplines covered by Scopus. Secondly, it proposes a robust methodology combining data cleaning and harmonisation (OpenRefine), performance analysis (Bibliometrix via Biblioshiny) and scientific mapping (VOSviewer), ensuring the reliability and reproducibility of the results. Thirdly, it clarifies the way in which the theoretical legacy of Knight and Keynes has been received, transformed or obscured over the last few decades, beyond the field of economics alone, thus revealing the truly interdisciplinary scope of the contemporary debate on radical uncertainty.

The article is divided into four sections. The first presents the data extraction strategy, the methodological approach followed and the tools used in data processing. The second section presents the results of the bibliometric analysis, distinguishing between performance analysis (changes in publications over time, contributing countries, affiliations, most active journals) and scientific mapping (keyword co-occurrence maps, co-authorship maps). The third section summarises the main results obtained, placing them within the theoretical framework of K&K uncertainty. Finally, the fourth section discusses the limitations of the study, in particular the constraints associated with the exclusive use of the Scopus database, the terminological limitations of the queries and the prospects for future work.

2. Methodology and tools

To answer the research question stated in the introduction, bibliometric analysis was chosen as the methodological approach. Defined as the application of mathematics and statistical methods to scientific publications (Pritchard, 1969), bibliometric analysis allows researchers to base their analyses on aggregated bibliographic data, reflecting the opinions of other scientists through their publications, citations and collaborations (Zupic and Čater, 2015). It mainly combines two bibliometric approaches: performance analysis and scientific cartography (Noyons et al., 1999 ; van Raan, 2005a ; Cobo et al., 2011 ; Zupic and Čater, 2015). Performance analysis, based on quantitative indicators (volume of publications, h-index, g-index and m-index), measures the academic productivity and scientific influence of work related to the research topic, while identifying key players (authors, institutions, countries) and influential journals. Scientific mapping explores conceptual and collaborative dynamics through keyword co-occurrence networks, co-citation graphs and thematic clusters, revealing the reappropriation or marginalisation of the concepts studied. The combination of these two approaches offers a more comprehensive and nuanced view of the scientific landscape.

The systematic collection of data used in this study began on May 16, 2025, using Elsevier's Scopus database. The choice of this bibliographic platform is justified, on the one hand, by its broad coverage of multidisciplinary scientific literature, carefully selected and regularly updated by an international committee of experts (Ahuja and Baishya, 2024), and, on the other hand, by the quality of its structured metadata (Ybarra, 2015), which is compliant and

indispensible for rigorous bibliometric analysis.

To ensure the relevance and consistency of the corpus to be analysed, access to the Scopus database and the formulation of the search query were structured according to a methodical strategy. This approach is based on a careful and thoughtful selection of a set of keywords rooted in the classic and contemporary terminology of K&K uncertainty.

In the TITLE-ABS-KEY field (recommended by Scopus), the keywords selected are:

> "Knightian uncertainty" OR "Keynesian uncertainty" OR "fundamental uncertainty" OR "radical uncertainty" OR "true uncertainty" OR "genuine uncertainty" OR "unmeasurable uncertainty" OR "non probabilistic uncertainty" OR "irreducible uncertainty" OR "deep uncertainty" OR "severe uncertainty"

This selection is based on the use of specific expressions that are well recognised in the literature dealing with non-probabilistic uncertainty. It aims to guarantee the accuracy of the results by directing the search towards works likely to be relevant to our issue, while ensuring broad disciplinary coverage. In all, 3438 documents were identified in this first identification stage (Figure 1).

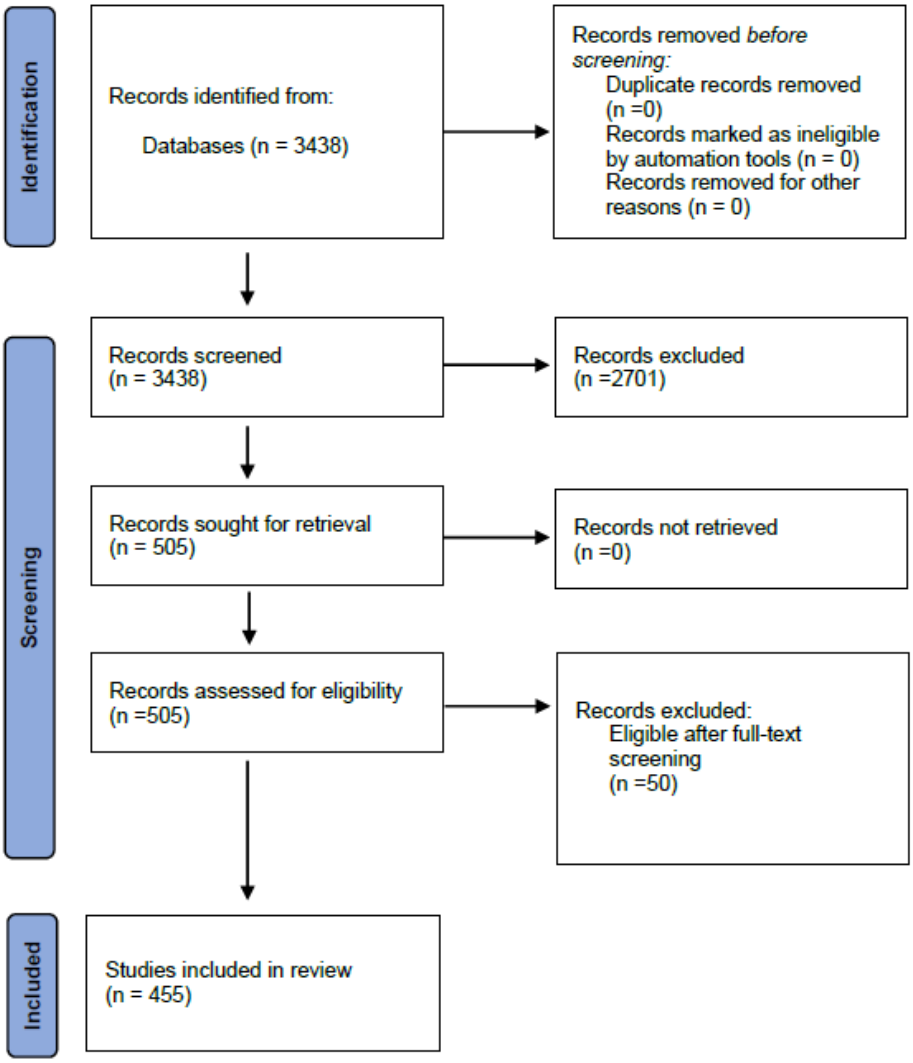
To strengthen the relevance of the query and minimise false positives, a first inclusion filter was added to the ALL field with the terms [AND ALL (Knight OR Keynes)]. This constraint helped to preserve semantic consistency by excluding documents containing generic terms with variable definitions that could introduce noise or false positives (2701 documents excluded). This deliberate approach is part of good methodological practice of bibliotmetric analysis. Refining search terms is essential to minimise bias and help preserve the internal validity of the corpus of data collected.

Finally, the last inclusion filters applied to the Scopus query limited the selection to scientific articles published in English, in their final version and prior to the current year 2025. This limitation made it possible to target a corpus of 505 documents consisting exclusively of peer-reviewed academic works, thus ensuring more rigour and scientific validity.

Thus, the final query retained for bibliometric analysis, after applying inclusion and exclusion filters, is formulated as follows:

> (TITLE-ABS-KEY ("fundamental uncertainty" OR "radical uncertainty" OR "Knightian uncertainty" OR "Keynesian uncertainty" OR "true uncertainty" OR "unmeasurable uncertainty" OR "non probabilistic uncertainty" OR "deep uncertainty" OR "severe uncertainty" OR "genuine uncertainty" OR "irreducible uncertainty") AND ALL (Knight OR Keynes)) AND PUBYEAR > 1976 AND PUBYEAR < 2025 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBSTAGE , "final"))

Figure 1. PRISMA Framework 2020



Source: Author, relying on the Scopus (2025) database.

During the eligibility stage, the remaining corpus was reviewed manually to exclude publications that did not directly address the central question of the study (50 documents excluded). This rigorous selection process aims to ensure the quality, relevance and consistency of the result, in accordance with the standards expected for a systematic review with a bibliometric focus.

Before conducting any bibliometric analysis, the bibliographic metadata extracted from Scopus in CSV format was imported into the free software OpenRefine for cleaning and harmonisation. This step proved essential to ensure the quality and consistency of the corpus. OpenRefine's effectiveness in processing metadata relies on three key features: Text Facet, clustering, and GREL (General Refine Expression Language). The Text facet option provided a concise and structured view of the data, facilitating the identification of missing values and the rapid and targeted correction of spelling variations in the corpus, particularly in the Affiliations, Authors with Affiliations and Author Keywords columns. The Clustering, using the “key collision” and “nearest neighbour” algorithms, made it possible to automatically detect and group similar values with slight syntactic variations, particularly in the Authors column. In addition, the GREL expression language made it possible to create custom clustering functions by offering great flexibility in developing grouping rules adapted to the specificities of the metadata.

After harmonising the corpus, the metadata set was exported in a CSV-compatible format so that it could be processed using bibliometric analysis tools. Although there are several software programmes dedicated to this task, Biblioshiny and VOSviewer were chosen for their complementarity, ease of use and ability to produce clear and more interpretable visualisations (Moral-Muñoz et al., 2020).

VOSviewer is particularly appreciated for its ability to construct and visualise complex networks from metadata (Van Eck and Waltman, 2010), including keyword co-occurrence networks, collaborations between authors, institutions or countries, as well as citation and co-citation networks. VOSviewer offers three main types of visualisations for exploring bibliometric networks. The Network Visualisation provides a classic graphical illustration where nodes represent items (authors, keywords, publications) and links illustrate the connections between them (co-citation, collaboration, co-occurrence). The size of the nodes is proportional to the importance or weight of the item, and the colours indicate clusters (thematic groups). The Overlay Visualisation adds a temporal dimension to the network visualisation by colouring the nodes according to a quantitative variable. This allows you to observe the temporal evolution of items within the network. Finally, the Density Visualisation uses a heat map to highlight the areas of the network where nodes are most concentrated, allowing you to quickly identify the densest thematic or collaborative regions. By default, these areas of high activity vary from blue to green and from green to yellow.

Biblioshiny, the graphical interface of the R package Bibliometrix (Aria and Cuccurullo, 2017), complements the analysis by providing an interactive and user-friendly platform for conducting advanced bibliometric analyses and generating a variety of visual outputs (graphs, maps, tables). With its clear and well-structured interface, Biblioshiny offers a wide range of analytical options, including the assessment of scientific output (by author or institution), the mapping of co-occurrences and citation networks, and the representation of knowledge across its social, intellectual, and conceptual dimensions.

The combination of these two tools has enabled bibliometric analysis to take advantage of both the advanced analytical capabilities of the Bibliometrix package in the R environment and the interactive network visualisations offered by VOSviewer, thus facilitating the interpretation and communication of the results.

3. Results

The results of the bibliometric analysis conducted in this study are structured around two complementary approaches: (a) performance analysis and (b) scientific mapping. The table below summarizes the main descriptive characteristics of the analyzed corpus, including the total number of documents, authors, and sources, as well as other general indicators related to the structure and composition of the bibliographic dataset.

Table 1. Summary of Main Information about Data

Description	Results
Timespan	1977:2024
Sources (Journals, Books, etc)	293
Documents	455
Annual Growth Rate %	7,99
Document Average Age	9,89
Average citations per doc	33,14
References	23916
Document contents	
Keywords Plus (ID)	1173
Author's Keywords (DE)	1193
Authors	
Authors	798
Authors of single-authored docs	149
Authors collaboration	
Single-authored docs	179
Co-Authors per Doc	2,18
International co-authorships %	22,64
Document types	
Article	455

Source: Author, relying on the Scopus (2025) database.

a. Performance analysis

i. Annual scientific production

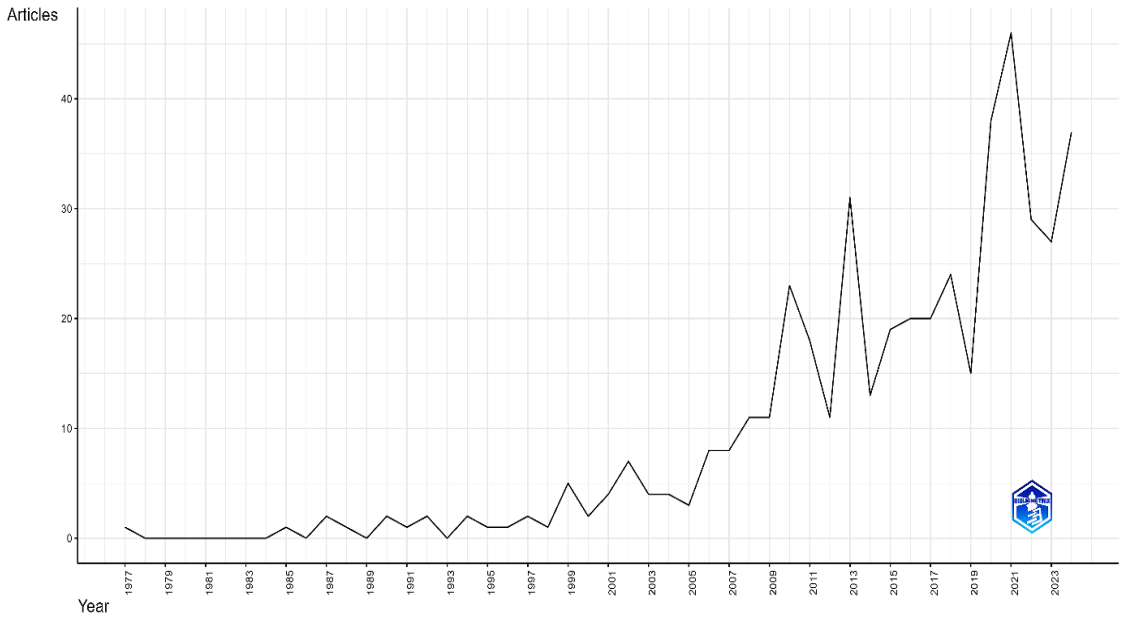
The annual evolution of the number of articles dealing with K&K uncertainty (Figure 2) reveals a dynamic marked by three distinct phases.

The first phase, from 1977 to the end of the 2000s, was characterised by sporadic and marginal scientific activity, with the number of publications fluctuating between zero and five articles per year. This low visibility can be explained by the dominance of probabilistic approaches to uncertainty to the detriment of the dichotomy introduced by Knight and Keynes.

The second phase, from 2001 to 2009, saw a moderate but notable increase in scientific interest, with annual output varying between 5 and 11 articles. Although this period was not marked by sustained growth, it nevertheless reflected renewed interest in the work of Knight and Keynes, particularly in the context of growing financial market instability. This dynamic was part of the aftermath of the subprime crisis that began in the United States in August 2007 and gradually spread to the entire global economy.

The third phase, which began in 2009, was marked by significant growth in the number of publications. A peak was observed in 2021 with 46 articles, followed by sustained levels of production in 2022 (29 articles), 2023 (27 articles) and 2024 (37 articles). This intensification can be explained in large part by the profoundly destabilising and radically unpredictable shock of the 2020 health crisis. The lessons learned from the financial crash, combined with the unprecedented effects of the Covid-19 pandemic, highlighted the limitations of traditional simulation and forecasting models in the face of extreme situations. These events have contributed to repositioning K&K uncertainty as a fundamental and essential dimension for understanding the upheavals and transformations taking place in the contemporary world.

Figure 2. Annual scientific production based on 455 Scopus research results between 1977 and 2024

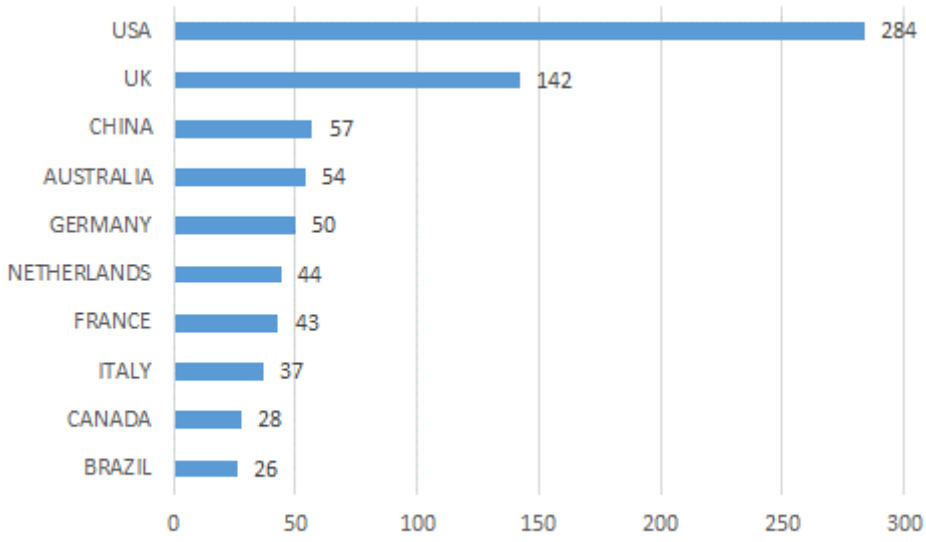


Source: Author, relying on the Scopus (2025) database.

ii. Top 10 most influential countries

An analysis of the geographical distribution of scientific output devoted to K&K uncertainty (Figure 3) reveals a high concentration of contributions in Anglo-Saxon countries.

Figure 3. Top 10 most influential countries measured by the frequency of their contributions



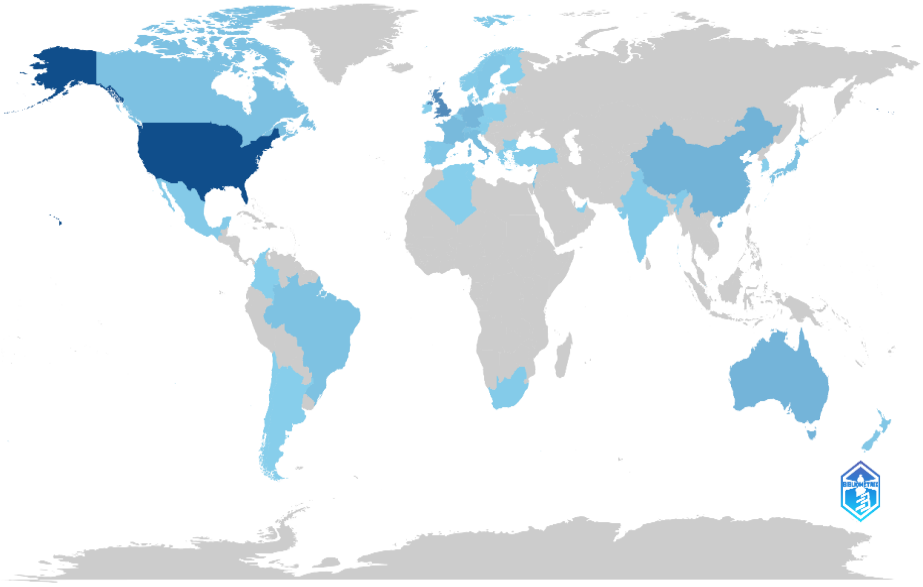
Source: Author, relying on the Scopus (2025) database.

The United States ranks first with 284 contributions, more than double that of the United Kingdom (142), which comes in second place. This American predominance can be explained

in particular by the intellectual proximity to the thinking of Knight (a founding figure of the Chicago School), as well as by the deep roots of the fundamental nature of uncertainty developed by Keynes and taken up by post-Keynesians in Anglo-Saxon macroeconomic debates.

China (57), Australia (54), Germany (50), the Netherlands (44), France (43), Italy (37), Canada (28) and Brazil (26) complete the ranking, illustrating a broader international dissemination of research on K&K uncertainty. This distribution reflects the growing interest of the global scientific community (Figure 4) in issues related to non-probabilistic uncertainty, particularly in a context marked by rising geopolitical tensions, climate challenges and profound changes in the global economy.

Figure 4. Countries' scientific production (Color scale ranges from dark blue for strong contribution to grey for no publications)



Source: Author, relying on the Scopus (2025) database.

iii. Top 10 most relevant affiliations

The ranking of the top ten contributing institutions (Table 2) reveals a strong predominance of North American (United States) and British universities, with a notable presence from Israel and Brazil.

The Technion – Israel Institute of Technology leads the way with 13 publications, closely followed by Cornell University (12) and University College London (10). American universities are the most represented with five institutions, accounting for a total of 41 articles.

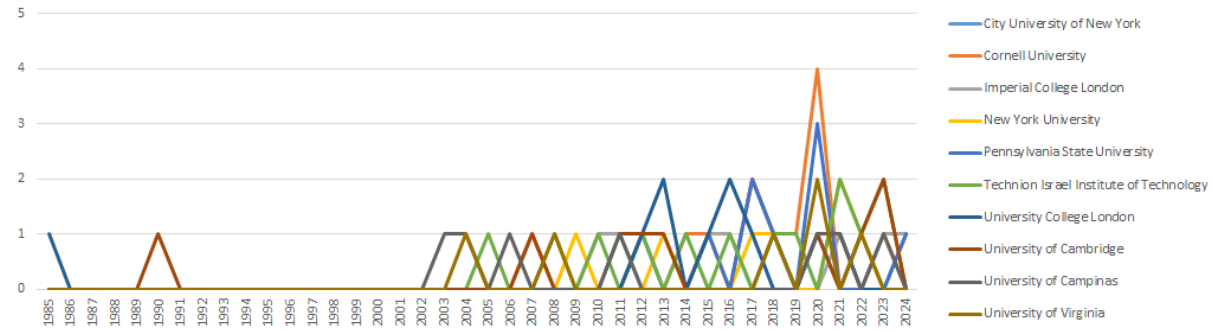
In terms of temporal dynamics (Figure 5), several institutions, in particular Technion, Cornell and the University of Cambridge, show marked growth from 2010 onwards, suggesting growing interest in the field studied or an increase in international collaborations on specific or conjunctural research projects. In 2020, these ten institutions produced a total of 13 publications, with notable contributions from Cornell University (4 articles) and Pennsylvania State University (3 articles), reflecting a peak in activity in this unprecedented year marked by the Covid-19 pandemic.

Table 2. Top 10 Most Productive Academic Institutions (ranked by publication count)

Affiliation	Articles	Country
Technion Israel Institute of Technology	13	Israel
Cornell University	12	United States
University College London	10	United Kingdom
Pennsylvania State University	9	United States
University of Cambridge	9	United Kingdom
New York University	8	United States
Imperial College London	8	United Kingdom
University of Campinas	7	Brazil
University of Virginia	6	United States
City University of New York	6	United States

Source: Author, relying on the Scopus (2025) database.

Figure 5. Production of the Top 10 Affiliations Over Time



Source: Author, relying on the Scopus (2025) database.

iv. Top 10 most productive scientific journals

Analysis of Table 3 reveals that a significant number of publications originate from journals related to heterodox economics, foremost among which are the Journal of Post Keynesian Economics (13 articles) and the Cambridge Journal of Economics (11 articles). These journals, historically rooted in the Keynesian tradition and breaking with mainstream economic orthodoxy, ensure intellectual continuity and provide a theoretical space conducive to updating and deepening the Knightian and Keynesian approach in light of contemporary issues. Despite a modest SJR (0.400) and an h-index of 50 for the Journal of Post Keynesian Economics, these journals represent a stable editorial hub committed to disseminating critical work on the foundations of economic rationality. Alongside these unorthodox contributions, other more generalist or pluralist economics journals complete this editorial landscape, such as Economics, Journal of Economic Theory and Review of Political Economy. Their presence testifies to a cross-disciplinary interest in the question of uncertainty and reflects an intellectual dynamism at the crossroads of economics, philosophy and political science.

Furthermore, certain journals, combining high visibility and strong academic impact, enrich scientific debate through their resolutely interdisciplinary approach.

Academy of Management Review, an international reference journal (SJR 14.402, h-index 320), has been actively participating in contemporary thinking on radical uncertainty since 2020 through several contributions. This emergence is no coincidence, as the publication of its five articles coincides with the health crisis, a context particularly conducive to critical reflection on

the determinants of organisational resilience, crisis governance and decision-making agility in an uncertain and unpredictable environment. From a more formalistic perspective, Theory and Decision (SJR 0.478, h-index 48) and Journal of Economic Dynamics and Control (SJR 1.714, h-index 106) stand out for their orientation towards quantitative approaches to decision-making in uncertain contexts. These journals favour contributions that combine theory and experimentation, with a strong mobilisation of mathematical and computational models. Finally, Environmental Modelling and Software (SJR 1.466, h-index 178) and Earth's Future (SJR 2.819, h-index 87) extend this disciplinary openness by anchoring uncertainty in environmental and climate issues. These journals tend to use numerical modelling and simulation to study complex systems subject to high levels of uncertainty.

Table 3. SCImago Journal Rank (SJR), CiteScore (CS), h-index and PY-start (publication starting year) of the 10 most productive scientific journals

Top 10 journals	Art.	SJR (2024)	CS	h-index	PY start	Subject area	Country *
Journal of Post Keynesian Economics	13	0.400 (Q3)	1.7	50	1996	Economics, Econometrics Finance	US
Cambridge Journal of Economics	11	0.848 (Q2)	4.3	103	1994	Economics, Econometrics and Finance	UK
Economics	8	0.342 (Q2)	1.0	28	2015	Economics, Econometrics and Finance	DE
Journal of Economic Theory	8	3.443 (Q1)	2.5	118	1994	Economics, Econometrics and Finance	US
Review of Political Economy	7	0.516 (Q2)	2.6	39	1990	Economics, Econometrics and Finance/Social Sciences	UK
Theory and Decision	7	0.478 (Q1)	1.6	48	1987	Economics, Econometrics and Finance/Social Sciences/Decision Sciences/Arts and Humanities/Computer Science an/Psychology	NL
Environmental Modelling & Software	6	1.466 (Q1)	9.3	178	2012	Computer Science and Environmental Science and Mathematics	UK
Journal of Economic Dynamics and Control	6	1.714 (Q1)	3.1	106	1995	Economics, Econometrics and Finance/Mathematics	NL
Academy of Management Review	5	14.402 (Q1)	24.6	320	2020	Business, Management and Accounting	US
Earth's Future	4	2.819 (Q1)	11	87	2007	Earth and Planetary Sciences/Environmental Science	US

* US: United States, UK: United Kingdom, DE: Germany, NL: Netherlands

Source: Author, relying on the Scopus (2025) database.

In short, an examination of these top 10 journals reveals a wide editorial diversity, bringing together journals on heterodox economics, advanced modelling platforms, journals specialising in environmental sciences, and publications on management and organisation. This coexistence reveals that radical uncertainty is no longer limited to the economic field alone, but it has now become a cross-cutting issue that federates several disciplines while challenging established

analytical frameworks.

v. Top 10 most productive authors

The analysis of the ten most prolific authors on K&K uncertainty (Table 4) reveals a diversity of theoretical and methodological approaches from a variety of disciplines. This heterogeneity reflects the complexity of the ways in which non-probabilistic uncertainty is apprehended and dealt with.

Table 4. Total Citations (TC) and h-index of the 10 most prolific authors

Authors	Art.	h-index	TC	Affiliation	Country
Ben-Haim Y.	13	7	129	Technion Israel Institute of Technology	Israel
Reed P.	12	11	841	Cornell University	United States
Izhakian Y.	6	5	222	City University of New York	United States
Keller K.	6	6	357	Pennsylvania State University	United States
Chiffi D.	5	3	50	Polytechnic University of Milan	Italy
Dequech D.	5	4	282	University of Campinas	Brazil
Dow S.C.	5	5	102	University of Stirling	United Kingdom
Runde J.	5	5	282	University of Cambridge	United Kingdom
Asano T.	4	2	24	Okayama University	Japan
Characklis G.W.	4	4	437	University of North Carolina	United States

Source: Author, relying on the Scopus (2025) database.

With 13 articles to his name, Ben-Haim (Technion, Israel) is the most prolific contributor to the corpus. His h-index of 7 and a total of 129 citations attest to his notable academic recognition. In collaboration with Stranlund from the Department of Resource Economics at the University of Massachusetts Amherst, Ben-Haim explores the comparison between price-based (taxes) and quantity-based (quotas) environmental regulations in a context of Knightian uncertainty, where the probabilities of future events are unknown (non-probabilistic). Drawing on info-gap theory (Ben-Haim, 2005), the two authors offer decision-makers a pragmatic approach to dealing with Knightian uncertainty: “Info-gap robust satisficing is a quantitative combination of Knightian uncertainty with Simon's concept of bounded rationality. The robust satisficing policy maker seeks a decision that satisfices performance and is robust to uncertainty” (Stranlunda and Ben-Haim, 2008, p. 444). This approach is based on the concept of robust satisficing, whose objective is not to optimise an expected outcome (probabilistic maximisation), but rather to choose policies that are sufficiently satisfactory (robust) in the face of large unknown variations in parameters.

With 12 articles, an h-index of 11 and a total of 841 citations, Reed (Cornell University, USA) is one of the most influential authors in the field of water planning under uncertainty. His article (183 citations), entitled “Beyond Optimality: Multistakeholder Robustness Tradeoffs for Regional Water Portfolio Planning under Deep Uncertainty”, was co-authored with several collaborators, including Characklis (University of North Carolina, USA), who has 4 articles, an h-index of 4 and 437 citations to his credit. The authors approach water planning through the lens of deep uncertainty, a concept similar to Knightian uncertainty: “Deep uncertainty acknowledges that decision makers may not be able to enumerate all sources of uncertainty in a system nor their associated probabilities” (Herman et al., 2014, p. 7692). By using multi-objective analysis and deep uncertainty exploration tools, the authors favour solutions that can keep up good performance across a wide range of uncertain futures. They suggest a robust multi-objective decision-making (MORDM) approach that focuses on robustness trade-offs between stakeholders rather than optimality. The authors favour management solutions capable

of maintaining satisfactory performance in a range of uncertain futures. This logic is extended by Keller (Pennsylvania State University, USA), author of 6 articles (h-index of 6, 357 citations), including "An Open Source Framework for Many-Objective Robust Decision Making" (122 citations), which proposes an open source methodological framework for robust multi-objective decision making called OpenMORDM. This framework contains two complementary components:

> (1) a software application programming interface (API) for connecting planning models to computational exploration tools for many-objective optimisation and sensitivity-based discovery of critical deeply uncertain factors; and (2) a web-based visualisation toolkit for exploring high-dimensional datasets to better understand system trade-offs, vulnerabilities, and dependencies' (Hadka et al., 2015, p. 1).

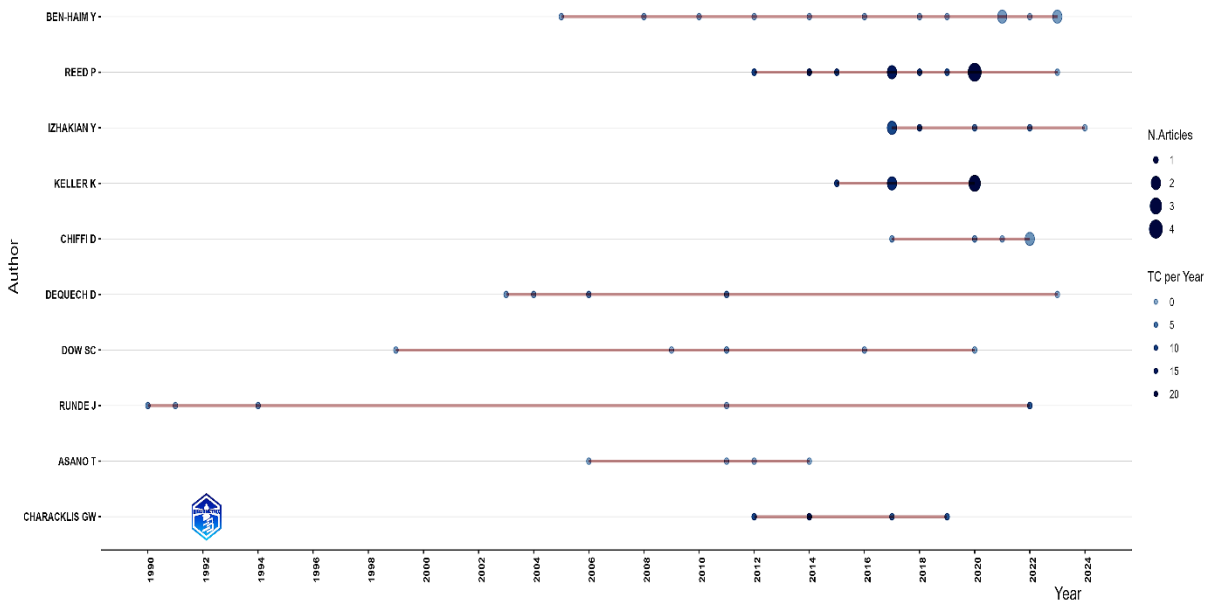
Furthermore, Izhakian (City University of New York, United States) and Asano (Okayama University, Japan) address Knight's uncertainty from complementary angles, combining economic theory and mathematical modelling. Izhakian, with 6 articles, an h-index of 6 and 222 citations, in his article "Asset Pricing and Ambiguity" (87 citations), takes an empirical approach to quantifying the impact of Knightian uncertainty, referred to as ambiguity, on stock markets. They develop "a new theoretically-based empirical methodology for measuring the extent of ambiguity using stock return data" (Brenner and Izhakian, 2018, p. 2). For his part, Asano, with 4 articles, an h-index of 4 and 24 citations, in "Portfolio Inertia Under Ambiguity" (10 citations), proposes a mathematical model of investor behaviour under non-probabilistic uncertainty, named ambiguity. He models the inertia of investment portfolios as a rational response to ambiguity, "under the assumptions that decision makers' beliefs are captured by an inner measure, and that their preferences are represented by the Choquet integral with respect to the inner measure" (Asano, 2013, p. 2).

Finally, Chiffi (Polytechnic University of Milan, Italy), Dequech (University of Campinas, Brazil), Dow (University of Stirling, United Kingdom), and Runde (University of Cambridge, United Kingdom) are part of a school of thought that seeks to draw on and deepen the Keynesian legacy of fundamental uncertainty, each with a distinct perspective. With five articles, an h-index of 3 and 50 citations, Chiffi revisits Keynes' uncertainty in his article "Fundamental Uncertainty and Values" (21 citations) through an ethical reading of judgement, emphasising the intertwining of Keynesian (fundamental) uncertainty and values in decision-making. He focuses his analysis on "the principle of uncertainty transduction in hypothetical retrospection as an illustrative case of how values interact with fundamental uncertainty" (Chiffi and Pietarinen, 2017, p. 1). Dequech (University of Campinas, Brazil), also with 5 articles, an h-index of 4 and 282 citations, adopts an institutionalist perspective. In his article "The New Institutional Economics and the Theory of Behaviour under Uncertainty" (89 citations), he discusses the influence of institutions on economic behaviour in situations of uncertainty. He highlights how institutions "can also be seen as reducing fundamental uncertainty. Through their cognitive function, in either of its forms, institutions give stability to people's way of acting, which in turn reduces the volatility of the economy (and reproduces institutions)" (Dequech, 2006, p. 120). Dow (University of Stirling, United Kingdom), with 5 articles, an h-index of 5 and 102 citations, revisits the notion of animal spirits in "Animal Spirits Revisited" (45 citations) from a post-Keynesian perspective, exploring how, in times of fundamental uncertainty, their nature and role can vary depending on the context, whether between "different sectors, types of firm and within firms" (Dow and Dow, 2011, p. 2). He considers "animal spirits" to be the foundation of non-routine action, operating alongside reason, evidence and conventional judgement, and capable of transcending Keynesian uncertainty (Dow and Dow, 2011). To complete this post-Keynesian landscape, Runde (University of Cambridge, United

Kingdom), with 5 articles, an h-index of 5 and 282 citations, provides an in-depth analysis in "Keynesian Uncertainty and the Weight of Arguments" (133 citations) of Keynes's views on probability, uncertainty and the weighting of arguments. His major contribution lies in his detailed explanation of the weighting process, which consists of assessing the relevance and weight of arguments in decision-making under uncertainty, clarifying the relationship between probability, certainty and uncertainty (Runde, 1990).

A summary of these authors' perspectives reveals a gradual interdisciplinary shift away from the classical conception of K&K uncertainty towards a contemporary tendency to integrate it into more pragmatic and operational approaches (Figure 6). This shift has resulted in increased use of modelling frameworks designed to support decision-making in uncertain contexts. Driven by authors with significant visibility and academic influence, this evolution has been expressed in particular through the use of info-gap theory, multi-objective robust decision-making (MORDM) and its open source extension OpenMORDM in environmental sciences, as well as through the use of mathematical modelling in decision theory and finance. Although these approaches recognise the dichotomy established by Knight, they nevertheless raise the question of a possible departure from the original interpretation of unmeasurable, unquantifiable uncertainty, as illustrated by the experience of the 2020 health crisis.

Figure 6. Authors' production over time



Source: Author, relying on the Scopus (2025) database.

b. Scientific mapping

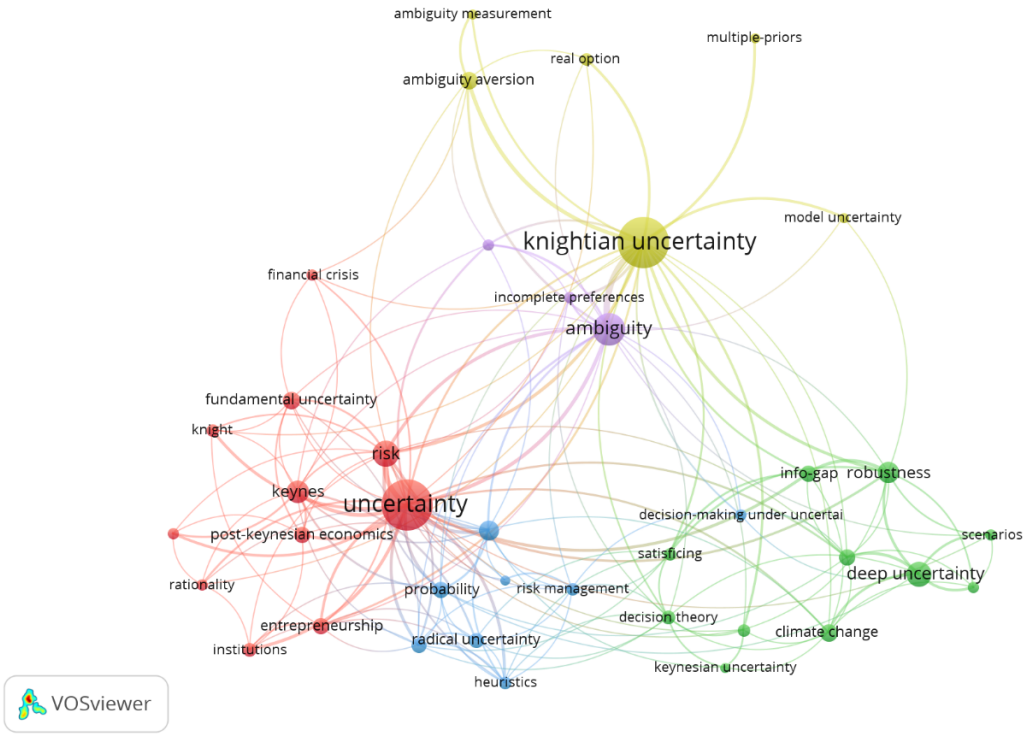
This second section uses an exploratory bibliometric approach, focusing on scientific mapping using the VOSviewer tool. The aim is to visualise the networks derived from the bibliometric corpus.

Several types of visualisation are used to shed light on the structure and evolution of the field of study. Mapping keyword co-occurrences will identify central concepts and dominant thematic orientations. Co-author analysis will highlight scientific collaboration networks and community structures. Finally, the analysis of sources and institutional affiliations will help to geographically and disciplinarily locate the major centres of scientific production. These different levels of interpretation allow for a more nuanced understanding of the scientific landscape surrounding K&K uncertainty.

i. Keyword Co-occurrence Analysis

The analysis of the co-occurrence network of authors' keywords (Figure 7) reveals five major thematic clusters, highlighting the main conceptual orientations and relationships within the corpus studied.

Figure 7. Author keyword co-occurrence network



Source: Author, relying on the Scopus (2025) database.

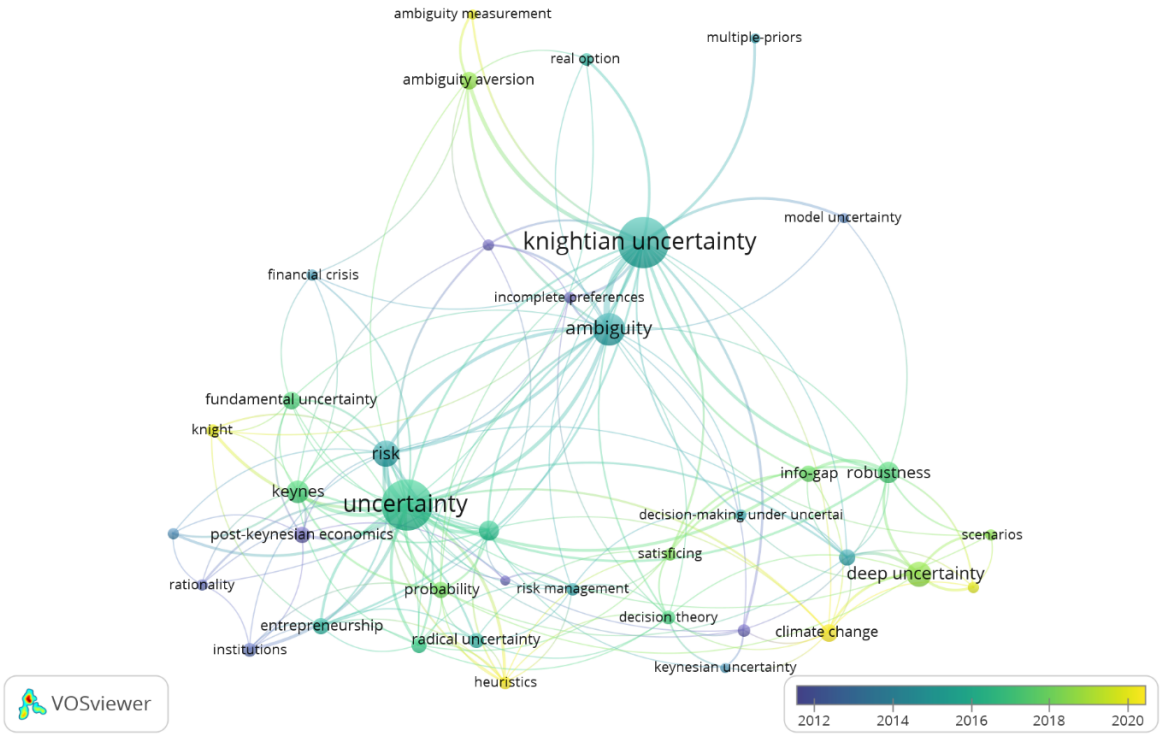
Cluster 1 (11 items in red) brings together fundamental concepts related to the thinking of Knight and Keynes. Keywords as “uncertainty” (105 occurrences) and “risk” (29 occurrences) dominate the field, indicating a central interest in the dichotomy between risk (calculable) and uncertainty (uncalculable). The presence of “Keynes”, “Knight”, “post-Keynesian economics” and “fundamental uncertainty” reflects a strong anchoring in the theoretical heritage of these authors, particularly in the post-Keynesian tradition. Terms such as “rationality”, “expectations”, “entrepreneurship” and “institutions” imply a socio-economic reading of uncertainty driven by macroeconomic dynamics and institutional systems. Cluster 2 (11 items in green) brings together methodological concepts like “robust decision-making”, “scenario discovery”, “satisficing”, “info-gap” and “scenarios”, which are related to decision engineering and show a desire to develop methods and tools that can simulate and model the major keyword “deep uncertainty” (27 occurrences). Although the theoretical basis remains present, via the terms “Keynesian uncertainty” and “decision theory”, the presence of the item “climate change” (14 occurrences) highlights the shift in uncertainty management, as defined by Knight and Keynes, towards applied issues. Cluster 3 (8 items in blue), with terms as “complexity”, “radical uncertainty”, “decision-making”, “heuristics” and “probability”, reflects the fundamental issues of “decision-making under uncertainty”, highlighting the need for effective and structured strategies (“uncertainty management” and “risk management”) to navigate complex and uncertain environments. Cluster 4 (6 items in yellow), centred on terms such as “ambiguity aversion”, “model uncertainty”, “multiple-priors” and “real option”, may refer to a

mathematical approach to decision-making in contexts of non-probabilistic uncertainty, particularly in finance (investment decisions). It combines theoretical and applied economic models to analyse the behaviour of agents faced with ambiguity, illustrated by the central keyword "Knightian uncertainty" (110 occurrences). Finally, Cluster 5 (3 items in purple) can be seen from an experimental and behavioural economics perspective, centred on "ambiguity" (44 occurrences). "Ellsberg's paradox" and "incomplete preferences" are mobilised to empirically question human decision-making behaviour in the face of non-probabilistic uncertainty.

In summary, this thematic structuring brings out three dimensions, linking on the one hand the theoretical legacies embodied by Clusters 1 and 5, and on the other hand the pragmatic and operational actions represented by Clusters 2 and 3, while Cluster 4 occupies a hybrid position, combining theoretical concepts and practical applications.

In terms of time, Figure 8 shows that most of the keywords associated with clusters 2, 3 and 4 are characterised by their freshness (lighter colours), representing a more recent publication average. This temporality reflects the topicality of the issues addressed by mobilising concepts as scenario discovery, deep uncertainty, robustness, info-gap, heuristics, ambiguity measurement and ambiguity aversion. The recent emergence of these terms once again demonstrates the evolution of the field of study towards more adaptive approaches, marked by a pragmatism and a practical spirit in the management of K&K uncertainty.

Figure 8. Author keyword co-occurrence over time



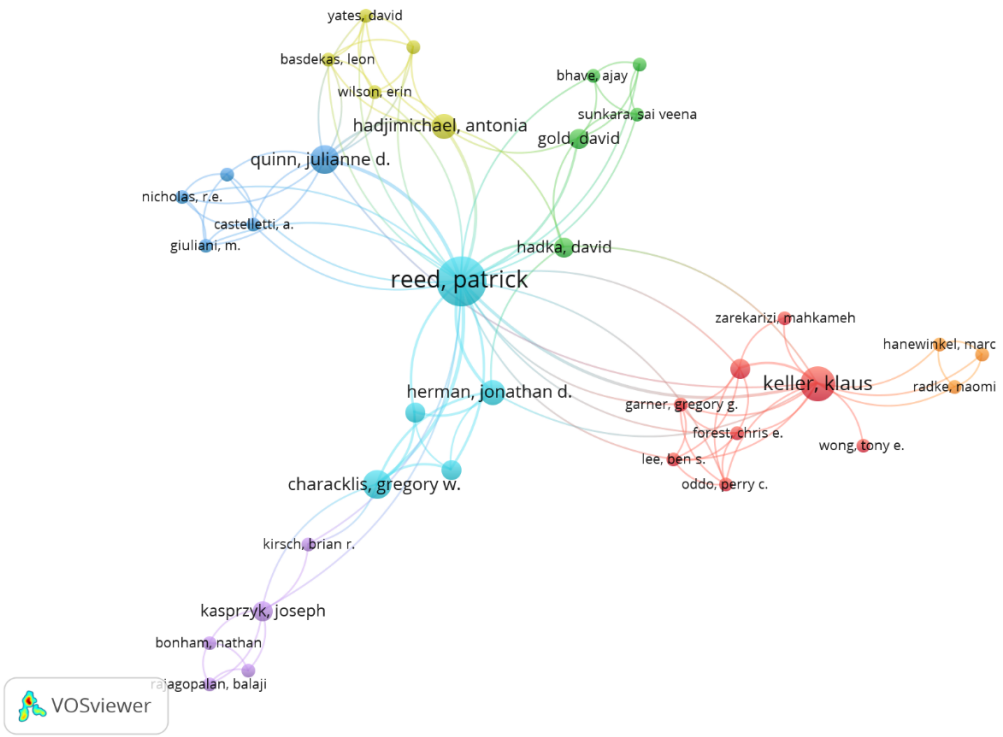
Source: Author, relying on the Scopus (2025) database.

ii. Co-authorship Network Analysis of Authors

The co-author graph (Figure 9) shows a collaboration network structured around three major scientific figures, whose influence is reflected in a high volume of publications, a significant

number of citations, and strong connectivity within the collaborative network. The trio includes Reed (Cornell University (USA) with 12 publications, 841 citations and a link strength of 43), Keller (Penn State University (USA) with 6 publications, 357 citations and a link strength of 17) and Quinn (University of Virginia (USA) with 4 publications, 213 citations and a link strength of 15). Although they belong to different clusters, these researchers share a common interest in environmental sciences and decision-making in uncertain contexts. Their work combines quantitative approaches, complex systems modelling and decision support tools, bringing together theoretical and applied perspectives. Their strategic position within the network reflects their structuring role in an expanding interdisciplinary field at the crossroads of environmental issues and challenges related to the profound nature of uncertainty.

Figure 9. Mapping of authors' collaboration network



Source: Author, relying on the Scopus (2025) database.

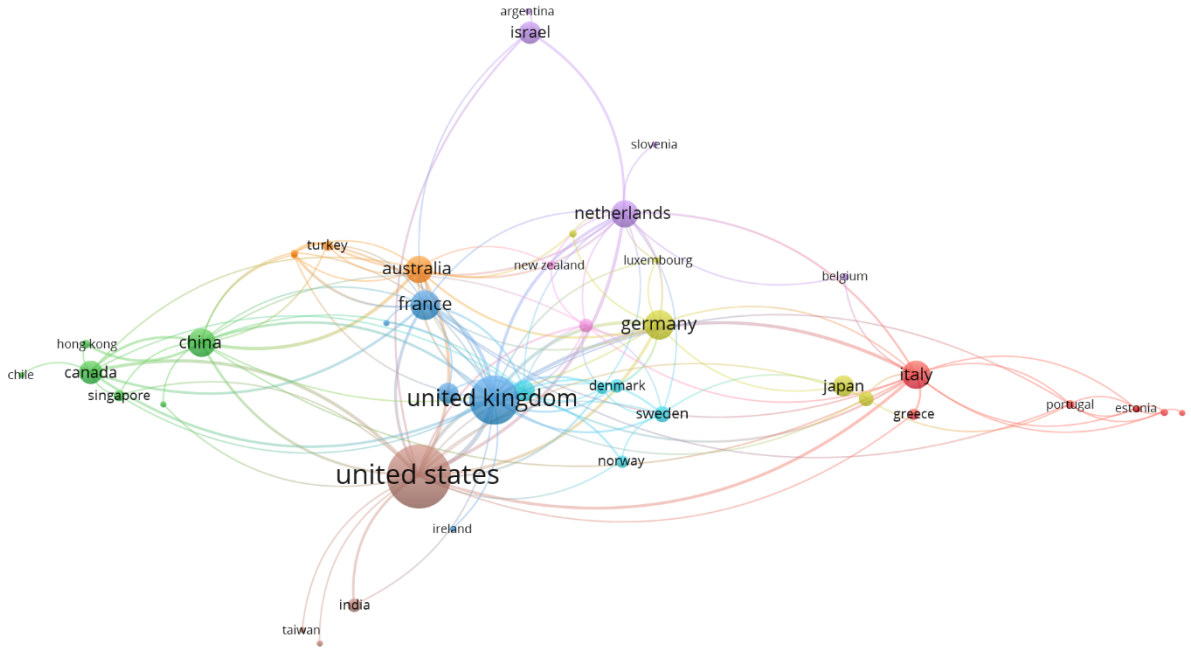
iii. Countries collaboration network analysis

The mapping of transnational cooperation (Figure 10) reveals nine distinct clusters, each presenting its own dynamics of production and scientific cooperation on uncertainty in Knight and Keynes.

Cluster 1 comprises seven European countries, where Italy stands out clearly for its scientific output and notable connectivity (30 documents, 491 citations and a link strength of 25), followed by Greece (5 documents, 139 citations and a link strength of 3) and Portugal (3 documents, 55 citations and a link strength of 7). The other countries in the cluster (Czech Republic, Estonia, Kazakhstan, Russia) make a marginal contribution, both in terms of publication volume and connectivity. Cluster 2 is structured around three geographical hubs, namely East Asia (China, Singapore, Hong Kong and South Korea), Latin America (Chile) and North America (Canada). Scientific collaboration in this cluster is mainly centred around China (30 documents, 300 citations and a link strength of 27) and Canada (21 documents, 497 citations

and a link strength of 19). Cluster 3 is dominated by the United Kingdom (90 documents, 3,195 citations and a link strength of 63), followed by France (33 documents, 876 citations and a link strength of 28) and Brazil (16 documents, 577 citations and a link strength of 5). This cluster has a high level of academic output and influence, with strong links between the main European and South American players. Cluster 4 is illustrated by the performance of Germany (34 documents, 1,314 citations and a link strength of 23), Japan (16 documents, 265 citations and a link strength of 2) and Spain (9 documents, 126 citations and a link strength of 6). Finland and Luxembourg are included with limited scientific and collaborative contributions. Cluster 5, dominated by the Netherlands (29 documents, 1,905 citations and a link strength of 30) and Israel (18 documents, 173 citations and a link strength of 7), shows international academic renown despite the presence of other countries with low collaboration and productivity (Argentina, Belgium and Slovenia). Cluster 6 mainly comprises European countries, with Switzerland (17 documents, 1,176 citations and a link strength of 22) and Sweden (10 documents, 575 citations and a link strength of 10) at the top, illustrating their central role in scientific production and collaboration within this group. In addition, Austria, Denmark and Norway make a more modest contribution. Cluster 7 is mainly led by Australia (29 documents, 1,319 citations and a link strength of 25), followed by Turkey, whose output is limited (4 documents, 17 citations and a link strength of 9). Lebanon and Vietnam have a more discreet presence in terms of output and links. Cluster 8 is characterised by a marked predominance of the United States (150 documents, 7,750 citations and a link strength of 63), which gives it significant leadership in terms of scientific output, academic influence and collaboration. India plays a more modest role (7 documents, 302 citations and a link strength of 4), while Taiwan and the United Arab Emirates have very limited involvement. Finally, Cluster 9 brings together New Zealand (3 documents, 14 citations and a link strength of 3) and South Africa (7 documents, 460 citations and a link strength of 12), marking a limited but well-connected presence in the global scientific space.

Figure 10. Network map of countries collaboration



Source: Author, relying on the Scopus (2025) database.

This division into clusters highlights a marked geographical contrast in scientific production and collaboration around K&K uncertainty. Anglo-Saxon countries (the United States, the

United Kingdom, Canada, and Australia) clearly dominate the field in terms of publication volume, number of citations, and connectivity, underscoring their role as scientific leaders and collaborative hubs. Countries such as the Netherlands, Switzerland and Sweden, despite more limited production, exert considerable influence thanks to their high visibility (high number of citations relative to the volume of documents) and integration into international scientific networks. On the other hand, several countries present in the clusters (Slovenia, Kazakhstan, Luxembourg, Vietnam, etc.) remain on the margins of the global network, with limited contribution and integration.

In sum, the concentration of connections around certain key countries (United States, United Kingdom, China, France and Germany) reflects an asymmetrical research landscape, where a small number of highly interconnected communities dominate collaborations on K&K uncertainty, thus reflecting a disparity in interest and enthusiasm for this field of research.

4. Conclusion

The objective of this study is to explore the place and evolution of the concept of uncertainty as defined by Knight and Keynes in the academic field, based on a bibliometric analysis. This approach has made it possible to map and analyse, using the most recommended tools (Moral-Muñoz et al., 2020), a corpus of articles from the Scopus database in order to better understand its evolution, dissemination and the different ways in which it has been appropriated. This work takes place in a context marked by recurring crises and a persistent climate of uncertainty, particularly economic, political and social, which weigh heavily on global prospects.

The main motivation behind this project is to shed new light on an issue that has been little explored in the existing literature. To date, only Hodgson's pioneering study (2011) has addressed this issue, focusing mainly on the eclipse of Knight and Keynes' uncertainty in mainstream economic thinking. Our work is based on a more ambitious approach, both in terms of the temporal and disciplinary scope of the corpus, but also in the use of advanced bibliometric techniques, in order to update and deepen this field of research.

The results obtained highlighted several major trends. The annual production of articles dealing with uncertainty, as defined by Knight and Keynes, has grown significantly since the 2000s, with an acceleration after the 2020 health crisis. This dynamics reflects a notable resurgence of interest in non-probabilistic uncertainty, in response to the failure and limitations of predictive models. The most active countries in this field are mainly Anglo-Saxon (United States, United Kingdom and Australia), with a rise in the influence of certain European (Germany, Netherlands and France) and Asian (China) countries. The most contributory academic institutions are based in the United States and the United Kingdom, with significant participation from those in Israel and Brazil. In terms of journals, the field of study is characterised by a wide editorial diversity, which goes beyond the strict framework of heterodox economics and is now establishing itself as a cross-disciplinary issue bringing together several disciplines such as environmental sciences, engineering, finance and organisational management. An examination of the most prolific authors has revealed a polarisation between those who seek to preserve the unmeasurable nature of uncertainty, faithful to the radical spirit of Knight and Keynes, and those who seek to operationalise it through robust decision-making approaches or mathematical models. This duality has gradually become more pronounced over time with a shift towards more pragmatic decision-making approaches, supported by influential and well-connected groups of authors, particularly in the fields of environmental science and decision engineering. The temporal co-occurrence of keywords supports this evolution, showing that key terms in the news (robustness, info-gap, heuristics, deep uncertainty or ambiguity measurement) are gaining visibility and tending to supplant the classic notions derived from the heterodox tradition in economics, thus marking a

form of reconfiguration in the understanding and treatment of uncertainty.

In summary, this study has shown that uncertainty as conceptualised by Knight and Keynes has not been eclipsed in the contemporary academic landscape. On the contrary, the financial crash of 2008 and the Covid-19 pandemic of 2020 have revived interest in their theory, highlighting its omnipresence and central role in understanding unpredictable events. However, this interest has not been limited to a return to the fundamentals of the risk/uncertainty dichotomy. Bibliometric analysis has revealed a shift towards integrating this uncertainty into decision-making frameworks that mobilise modelling approaches and mathematical methods with the aim of formalising and making decision-making more operational in an unpredictable environment.

5. Limitations and future research

Despite its contributions, this research has certain methodological limitations that should be highlighted. First, the exclusive use of the Scopus database. Although renowned for its extensive coverage of scientific publications, this platform may introduce selection bias, particularly by excluding articles indexed in other databases such as Web of Science or JSTOR. In addition, the choice of keywords and filters applied during the query may have resulted in a partial selection of the literature, potentially excluding relevant works that do not strictly correspond to the terms used, are published in other formats (book chapters, papers, theses) or are written in other languages. In this respect, our study does not close the debate but rather opens up new avenues for reflection and investigation, inviting a more in-depth and nuanced exploration of the subject.

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