

Mapping the Research Landscape of Robo Advisor Adoption: A Bibliometric Analysis

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Abstract. The rapid development of fintech in the investment industry has brought significant influence and disruption to the wealth management sector. As digitization continues to permeate the industry, the adoption of robo-advisors as automated investment solutions has gained prominence. This paper contributes to the field by presenting a novel econometric literature analysis of academic research on the adoption of robo-advisors. Using tools such as VOS Viewer and Biblioshiny, this study examines a comprehensive database of Scopus, analyzing 383 documents to identify key metrics, such as influential publication sources, keywords, countries, affiliations, and authors. The results reveal a growing number of publications on robo-advisors, indicating a rising interest and enthusiasm for future research on this topic among the scientific community. This finding signifies the importance of understanding and exploring the implications of robo-advisor adoption in the wealth management industry. It underscores the need to navigate the evolving landscape of fintech and its impact on the wealth management sector. Ultimately, this research contributes to our understanding of the ongoing transformation of the industry and highlights opportunities for further investigation in this dynamic field.

Keywords: Robo advisor, intention to use, adoption, bibliometric analysis

1. Introduction

The mortgage financial crisis in 2007/2008 influenced technology innovation, such as robo-advisors, in the wealth management industry. Robo-advisors are robotic services that have entered the banking and investment sectors due to technological advancements (Bhatia et al., 2021). They provide and recommend portfolios based on the investor's risk profile without human intervention processes (Moulliet et al., 2016)(Sironi, 2016).

The robo-algorithm will provide an assessment of the investors' answers related to their attitude to losses, their income, investment objectives, and others. Currently, the development of robo-advisors has the potential to grow to an AUM of USD 2 trillion (Better Finance, 2020) and expand to Asia, including Indonesia.

In Indonesia, robo-advisors have been embraced by several fintech companies that work with Common Support Offering Specialist permits, speculation admonitory, and budgetary organizer sandboxes from the OJK. The increased access to speculation fintech appears to have increased the number of speculators in Indonesia, which was already very moderate. The number of capital showcase speculators in Indonesia has expanded as online applications have increased the public's access to stock exchanges, shared stores, and other showcased capital budgetary disobedient. Studies have also shown that robo-advisor development will lead to completely computerized portfolio counsel or aim to remove human involvement in decision-making processes (Moulliet et al., 2016).

Bibliometric analysis is a comparatively new method and is an increasingly common research method in various fields, including finance. This article provides a bibliometric analysis of automated financial advisors (robo-advisors). The mathematical study of science and scientific research is known as scient metrics, and one subfield of scient metrics is bibliometric analysis. The quantitative processing of bibliometric data, such as published sources, is a prerequisite for the bibliometric research methodology.

Content evaluation of relevant literature has become very difficult due to the exponential increase in academic publications. However, the retrieval of relevant academic literature has been made easier by several different visualization approaches (Borner et al., 2003). By organizing the academic literature relevant to a research topic in a bibliometric analysis, for instance, greater conceptualization and comprehension of research subjects are made possible (Aria & Cuccurullo, 2017)

The bibliometric analysis allowed us to understand and analyze the huge expansion of data published on the topic since the first published document in 2016 until now. This paper will analyze research on robo-advisors and its adoption using Vos Viewer and Biblioshiny. Both software creates data-reflecting graphics with various attributes from multiple data sources. Researchers can efficiently and effectively organize information through the visual mapping of published literature. In addition, this analysis method allows the authors to identify significant research trends and the authors and articles most frequently cited within an enormous body of scholarly publications on a given topic. Moreover, the bibliometric analysis can determine the development of robo-advisor research and its close relationship with recent technology and artificial intelligence. Bibliometrics can also provide a scientific description of descriptive research on a particular topic, can determine which publishers issue many papers on a particular topic, and which countries, journals, and authors influence the research topic.

No previous publication has used this methodology to analyze robo-advisor development and its adoption. Therefore, this paper aims to minimize that knowledge gap and offer a comprehensive overview of the development and connections between different research areas and identified papers and authors who have acknowledged the use of robo-advisors.

This study might be the first analysis to investigate the robo-advisor topic with bibliometric analysis. The Biblioshiny and VOS viewer software were used to address the following research questions: What is the coverage of the literature study on automated advisors? What is the most significant contribution

to the robo-advisor subject? What are the primary tendencies of robo-advisors? What theories are commonly used for the robo-advisor topic? The authors believe that the subject of robo-advisors and its adoption is novel, and this research can serve as a helpful starting point for future research on this topic.

2. Related Studies and Background

Several factors are driving users to adopt robo-advisors, and most researchers refer to the theoretical basis of the Technology Acceptance Model (TAM) for this phenomenon (Davis, 1985). perceived usefulness and perceived ease of use are the core variables of the TAM. In the robo-advisor context, an application's convenience will provide benefits for its users and contribute to perceived usefulness and ease of use. Moreover, the original TAM theory involves flexibility. Research conducted by (Volker Seiler & Fanenbruck, 2021) examined the adoption of robo-advisors in Germany with the development of the TAM theory and added external constructs to intention to use from the perspective of content, design, risk, privacy, and demographic and fintech special controls. They found that perceived usefulness and perceived privacy are the most influential factors in the intention to use robo-advisors. Another research by (Daniel Belanche et al., 2019) developed the TAM theory by adding the attitude and subjective norms variables, which are the main variables in the theory of planned behavior (Ajzen, 1991). These two variables are keys to the adoption of robo-advisors. Therefore, perceived usefulness, as a part of TAM, influences users' intention to use robo-advisors and subjective norms significantly influence users with low knowledge of robo-advisors.

Another theory used in robo-advisor adoption is unified theory of acceptance and use of technology/UTAUT (Venkatesh, 2003). The four main variables used are performance expectancy, effort expectancy, social influence, and enabling conditions. Gan et al., (2021) examined the adoption of robo-advisors in Malaysia during the COVID-19 pandemic based on the UTAUT theory. Their research used three variables: trust, perceived financial knowledge, and tendency to rely on robo-advisors. They found that the main construct variables that have an effect are only performance expectancy and social influence. Moreover, additional variables such as trust factors, perceived financial knowledge, and tendency to rely on robo-advisors also influence the intention to use robo-advisors. Furthermore, Gerlach & Lutz (2021) combined two theoretical approaches: the Net Valence Theory and UTAUT2, to determine the intention to use Digital Finance Advice Solutions (DFAS or robo-advisors). All independent variables have an effect at 1%, 5%, and 10%, and only the convenience construct has no effect, which is part of the perceived benefit variable. Meanwhile, the perceived risk variable influences the intention to use DFAS.

Robo-advisors are a new technology, and research on this topic is still scarce. Jung et al., (2018) explore the picture of robo-advisors and the potential for a more comprehensive data-based risk assessment model to help reach a fully automated stage, configuration stage information asymmetry with customers, matching and customization through information transformed in recommendations, and customer service based on technology that suits their needs.

Robo technology has continued to evolve and aims to reach a fully automated stage in the future (Moulliet et al., 2016). Thus, more qualitative research is needed to explore this field deeply. One of the qualitative studies conducted by Bhatia et al., (2020) involved experts and top management in finance and fintech in India to explain a deep understanding of the capabilities of robo-advisors in mitigating behavioral bias, increasing the level of awareness among investors through education, and building trusts. This is important because robo-advisors have yet to accurately and precisely analyze investors' risk profiles comprehensively. To obtain in-depth insight from the user's point of view, (Ankita Bhatia et al., 2021) also conducted further research from the perspective of investor intentions in using robo-advisors. Cost-effectiveness, trust, data security, behavior bias, and investor sentiment are important points that influence investor perceptions. Moreover, some investors used robo-advisors as an alternative and complementary service, not a substitute for investment advisors.

The lack of comprehensive and in-depth understanding of robo-advisors is why this service is not considered a main tool in making investment decisions. However, there is a belief that robo-advisors will become a new investment trend. It is estimated that in the next five years, there will be a new style of investing in the Indonesian people. Several factors, such as the ease applications provide to determine investment decisions, trust through the company's permits from the regulator, more competitive return expectations, minimal or no costs, transparency, no bias, no human interaction, and more diverse products provide the potential for greater adoption of robo-advisors in Indonesia. In addition, a low minimum investment amount will increase robo-advisors' reach to all market segments in Indonesia. Reher & Sokolinski (2020) proved that reducing the minimum amount of investment encourages the democratization and growth of robo-advisor users in the middle class. A minimum investment of IDR 100,000 is a very affordable amount for beginners who have never invested and is believed to be low enough to reach the lower, middle, and even upper-middle-class market segments.

In summary, the TAM and UTAUT theories are widely used in robo-advisors technology adoption research. Both theories refer to the planned behavior theory (Ajzen, 1991). Moreover, Belanche et al., (2019), Volker Seiler & Fanenbruck, (2021), Yi-Cheng Ku & Wang, (2022), and Gianna Figà-Talamanca et al., (2022) used these theories in their robo-advisor studies. Based on the Vos viewer analysis, publications on the robo-advisor topic can be divided into three major clusters: robo-advisor algorithm, intention factors influence, and fintech. Besides being a form of financial innovation, robo-advisors are closely related to finance, especially investment. The decision to use new technology is also based on an individual's behavioral decision. These behaviors can be described by using the following theoretical bases: Theory reasonable Action (TRA), Theory Planned Behavior (TPB) by (Ajzen, 1991), TAM (Davis, 1985) & UTAUT (Venkatesh et al., 2003). Some studies have also recently used the Diffusion Innovation Theory (DIT) (Roger, 1962) and the Expectation Confirmation Theory (ECT) (Oliver, 1980).

This study will first explore the research published on the robo-advisor topic in innovation fintech studies. Next, the intention to adopt robo-advisors will be discussed by using TAM and UTAUT and several new constructs with quantitative and qualitative methods. The final part of this research will summarize the theoretical basis that could be applied to robo-advisor adoption used by previous researchers and the potential for novelty for future research.

3. Methodology & Data Collection

3.1. Data Collection

Scopus is widely regarded as one of the most distinguished multidisciplinary abstract and citation databases. Access to peer-reviewed academic publications, including books, journals, and symposiums, is made simple by Scopus. In the metadata they provide, the publishers include the names of the authors, their affiliations, the year the document was published, the electronic identity (EID) of the paper, the title of the source, the volume/issue/pages, the number of citations, the source, the document category, and the identifier for the digital object (DOI). Scopus contains over 84 million data records from over 7,000 publishers in 27,000 journals. According to Elsevier's data Fast-Fact website, the company's articles account for approximately 18% of global research and 28% of citation share. Additionally, Biancone et al., (2020) concluded, based on the preceding information, that the Scopus database is an excellent and trustworthy resource for bibliometric analysis. Thus, the authors of this paper conducted their bibliometric research using the Scopus database.

The research data on Robo advisor investment and adoption, as retrieved on January 25, 2023, is summarized in the paper's bibliometric analysis. The Scopus database was searched using the terms "Robo advisor" OR "Robo advice" OR "Robo investment" AND "Intention use" OR "Adoption" to gather the relevant data. These keywords were selected to find research that specifically discuss robo-advisors and intentions. As the same of the words robo-advisor and robo-advice because they have

similarities, including the intention to use with adoption. Therefore, these keywords will specifically produce relevant research output. The Scopus database's published article titles, abstracts, and keywords were used in the search. Numerous genres, including novels, articles, book chapters, conference papers, book reviews, and books, were investigated in the study. Only existing English-language publications were selected in this study. Overall, the Scopus search resulted in 383 outcomes.

3.2. Method

The research question is addressed in this paper using three separate econometric literature analysis techniques: performance analysis, scientific mapping, and network analysis (Donthu et al., 2021). Performance analysis examines the number of relevant publications and citations to determine how many authors, journals, and countries contributed to research on the robo-advisor adoption topic (Donthu et al., 2021). This method shows which journals, authors, and articles are the most cited or useful. Next, scientific mapping techniques allow the researcher to show how different pieces of research on a certain topic relate to each other. This approach defines publications, underlying themes, and relationships between topics by performing different types of analyses, such as citation and co-citation analysis, collocation analysis, and co-authorship analysis. Finally, the last technique is network analysis, where clustering and network metrics are used to show different results. Figure 1 shows how the data extraction and bibliographic analysis were conducted.

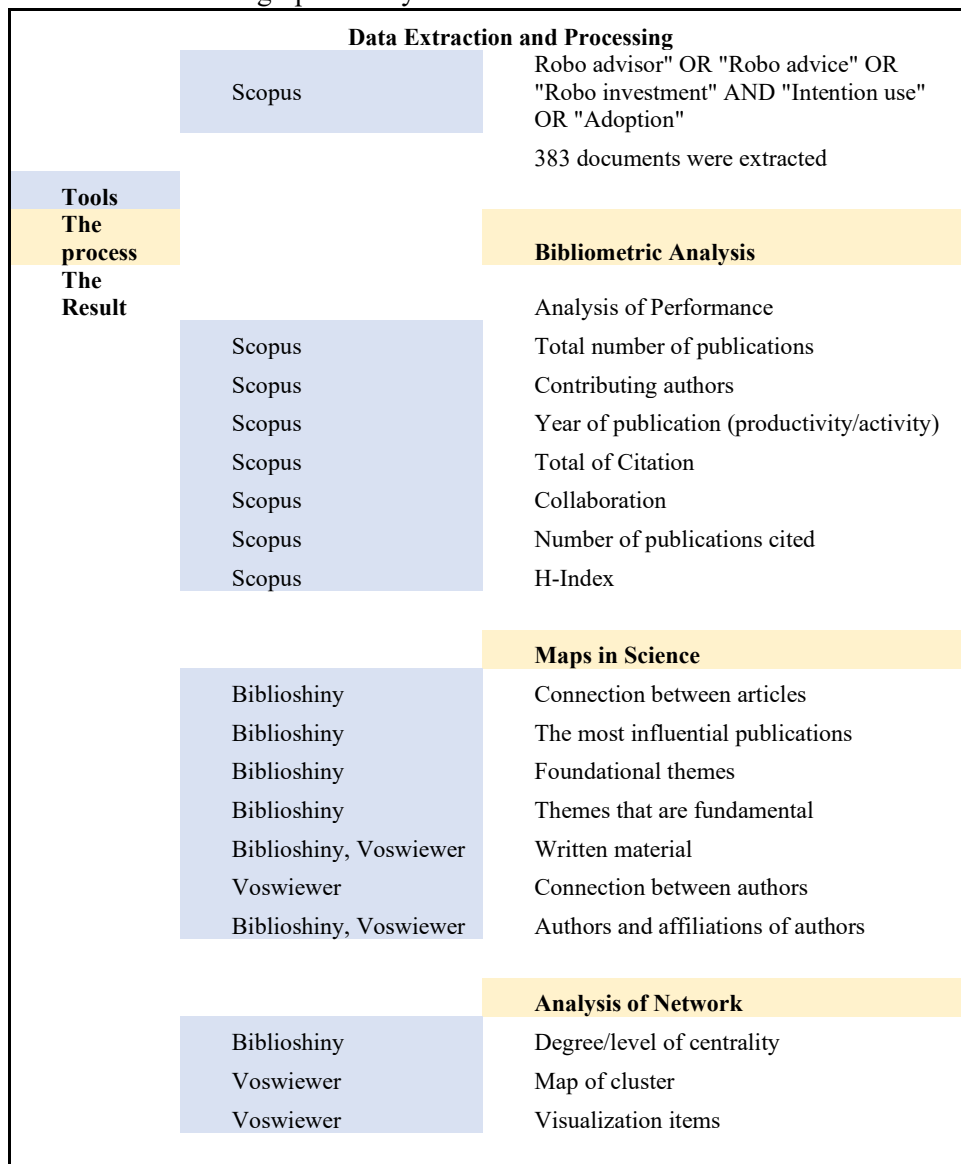


Fig. 1: Summary of the operational procedure

4. Results on Bibliometric Analysis

The search with the keywords "Robo advisor" OR "Robo advice" OR "Robo investment" AND "Intention use" OR "Adoption" generated 383 documents. The results indicate a substantial academic interest in robo-advisors and its adoption. Table 1 shows that articles and conference papers comprise most of the identified documents (69% and 17% of all documents, respectively). Followed by reviews (7% of the documents identified), book chapters (4%), and books (3%). The lower number of reviews, book chapters, and books identified suggests the relative novelty of the subject.

Table 1: Principal data information, from the first paper published on the Robo advisor topic to January 25, 2023

Description	Result
Article	263
Conference paper	64
Review	26
Book chapter	15
Book	13
Editorial	2
Total Documents	383
Annual growth rate	52.29
Average citations per doc	11.57
Single Authored Docs	50
Co-Author per Doc	2.94

Source: Scopus, Bibiloshiny

The documents extracted from Scopus for all years were further filtered to those published in 2016 and onwards. A total of 1 document was published in 2016 by the International Conference on Information Systems, ICIS 2016, with the title "FinTech - What's in a name?" by Zavolokina et al., (2016). The paper explores and describes general fintech. Although it does not specifically focus on robo-advisors, it mentions robo-advisors as a form of fintech innovation. Next, a total of 4 studies were published in 2017. These studies explore digital finance and fintech and mention Robo-advice as a form of innovation in digital finance (Gomber et al., 2017), how robo-advisors dominate the market volume in fintech businesses as the largest compound annual growth rate in Germany (Dorfleitner et al., 2017), and how robo-advisors are an innovation that functions without human intervention and needs regulations in Malaysia (Oseni & Omoola, 2017). The last paper by Godwin (2017) explores how digital disclosure interacts with Robo-advice in Australia.

The robo-advisors topic has been growing rapidly, with an average of 150% annual growth since 2016. The topic of robo-advisors and the intention to use and adopt it began to be specifically researched in 2018 and has continued until this study's year of publication (D Jung et al., 2018), (Bruckes et al., 2019), (Rühr et al., 2019), (D Belanche et al., 2019), (D Belanche et al., 2020), (Ankita Bhatia et al., 2020), (Lourenço et al., 2020), (Niszczoła & Kaszás, 2020), (Fan & Chatterjee, 2020), (W. Noonpakdee, 2020), (Cheng, 2021), (Gan et al., 2021), (V Seiler & Fanenbruck, 2021), (Ankita Bhatia et al., 2021), (G Atwal & Bryson, 2021), (Wu & Gao, 2021), (Ankita Bhatia et al., 2022), (Piehlmaier, 2022), (Y.-C. Ku & Wang, 2022), (G Figà-Talamanca et al., 2022), and (Yeh et al., 2022).

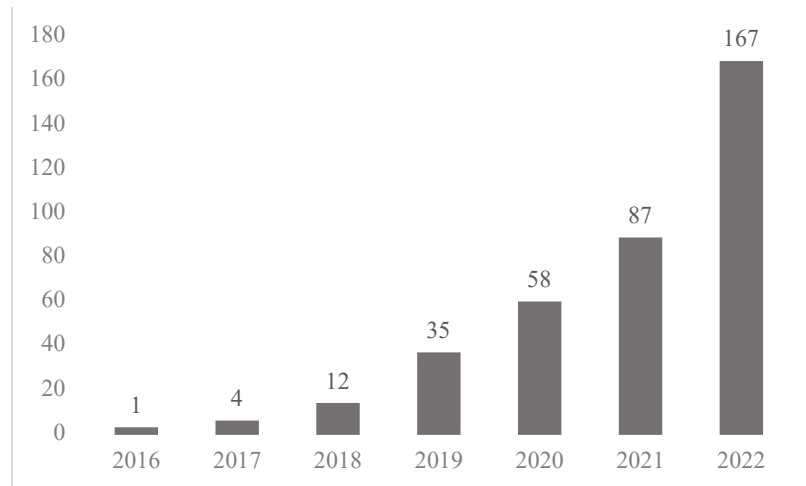


Fig. 2: The yearly number of scientific studies on robo-advisors
Source: Scopus and created by Excel

4.1. Source publications and Analysis

4.1.1. Publication Focus Areas

The subject matter of robo-advisors and its adoption are extensive and diverse (Table 2). Most publications (27%) are in the field of business, management, and accounting, followed by computer science (21%), economics, econometrics and finance (14%), and social sciences (10%). The large number of studies in these four areas is because the robo-advisors topic is a combination of financial technology, artificial intelligence (computer science), and management and economics for investment portfolio management.

Table 2: The publications' subject matter areas

Subject Area	Number of Results	%
Business, Management and Accounting	194	27%
Computer Science	151	21%
Economics, Econometrics and Finance	105	14%
Social Sciences	73	10%
Engineering	51	7%
Decision Sciences	34	5%
Mathematics	27	4%
Psychology	19	3%
Environmental Science	18	2%
Arts and Humanities	12	2%
Energy	10	1%
Medicine	8	1%
Multidisciplinary	5	1%
Physics and Astronomy	5	1%
Agricultural and Biological	4	1%
Materials Science	4	1%
Others	8	< 1%

Source: Scopus, created in Excel

4.1.2. Most Cited Publication Source

Table 3 displays the 20 most-cited publication sources for articles on robo-advisors and its adoption. The five most cited sources are the Journal of Management Information Systems, Journal of Business Economics, Service Industries Journal, Small Business Economics, and Industrial Management and Data Systems. Each of these five publications had more than 100 citations in this analysis. They are also in the first quartile (Q1) journal group ranking, indicating that they are of adequate quality for this

analysis.

Table 3: Subject areas of the publications

Publications	Number of Citations
Journal of Management Information Systems	411
Journal of Business Economics	368
Service Industries Journal	193
Small Business Economics	184
Industrial Management and Data Systems	143
Electronic Commerce Research and Applications	141
Electronic Markets	106
Journal of Business Research	104
Journal of Environmental Management	95
Journal of Service Management	85
FinTech in Germany	84
Business and Information Systems Engineering	83
Electronic Markets	68
Journal of Business Research	67
Journal of Theoretical and Applied Electronic Commerce Research	65
Electronic Markets	64
International Review of Economics and Finance	62
2016 International Conference on Information Systems, ICIS 2016	62
Electronic Markets	57
Sustainability (Switzerland)	50

Source: Scopus, created in Excel

4.1.3. Most Cited Publication Source Based on Country

Figure 3 shows the number of citations of papers about robo-advisors and its adoption, based on publication country. The number of citations was dominated by the USA and Europe (Germany and Spain). This is understandable, given that Betterman emerged as a disruptor in the wealth management business following the 2008 global financial crisis. Likewise, European countries followed suit. Documents that originated from Germany had the highest number of citations (841), with an average of 30.04 article citations, followed by USA (574) with an average of 22.04 citations per article, and Spain (401) had an average citation of 33.42 per article.

Figure 4 shows the top 10 most cited sources. The top five sources of citations include reputable journals, such as the Journal of Management Information Systems, Journal of Business Economics, Service Industries Journal, Small Business Economics, Industrial Management and Data Systems. These five journals are included in Q1.

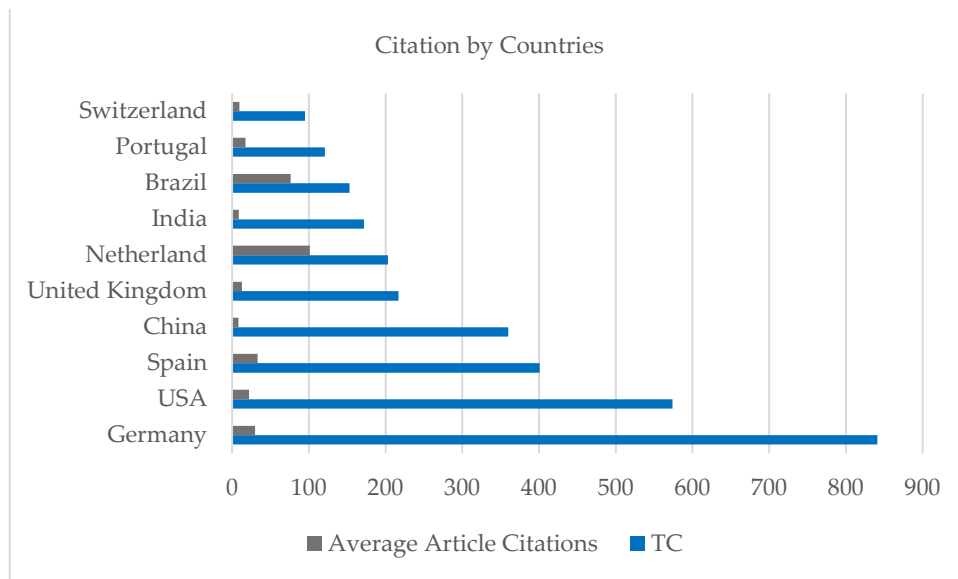


Fig. 3: Most cited documents according to publication country

Source: Scopus, elaborated in Excel

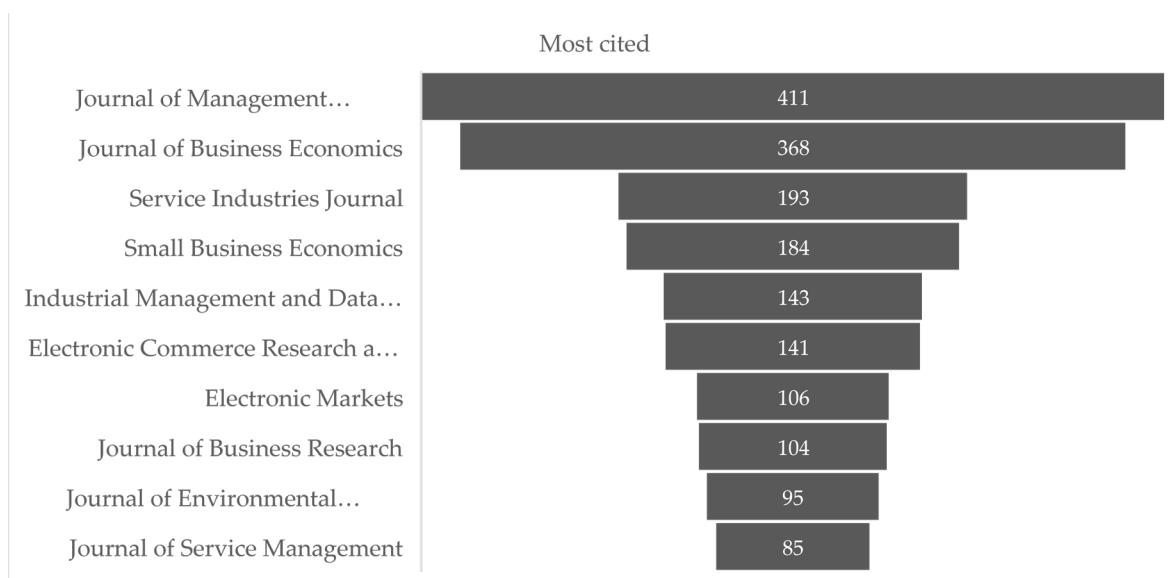


Fig. 4: Most cited publication sources. Source: Scopus, created in Excel

4.2. Document Analysis

4.2.1. Publications with the most citations

Figure 5 exhibits the number of citations received per author. Based on the analysis of the co-authors, there are still few author collaborations on the topic of robo-advisors and its adoption. There are only two small networks viz the research by Belanche et al., (2019; 2020; 2021) and (Mesbah et al., 2019). The article published in the Service Industries Journal by D Belanche et al., (2020) is the most cited document on robo-advisor and its adoption, with 193 citations. In total, there are 485 citations from articles published between 2019 and 2021. Although Belanche et al., (2019; 2020; 2021) did not have the highest number of citations, in terms of specific explanations, their studies on robo-advisors were widely used as references by subsequent researchers compared to Gomber et al., (2017; 2018), who focused on discussing general fintech topics, with 368 citations in 2017 in the Journal of Business Economics and 411 citations in 2018 in the Journal of Management Information Systems.

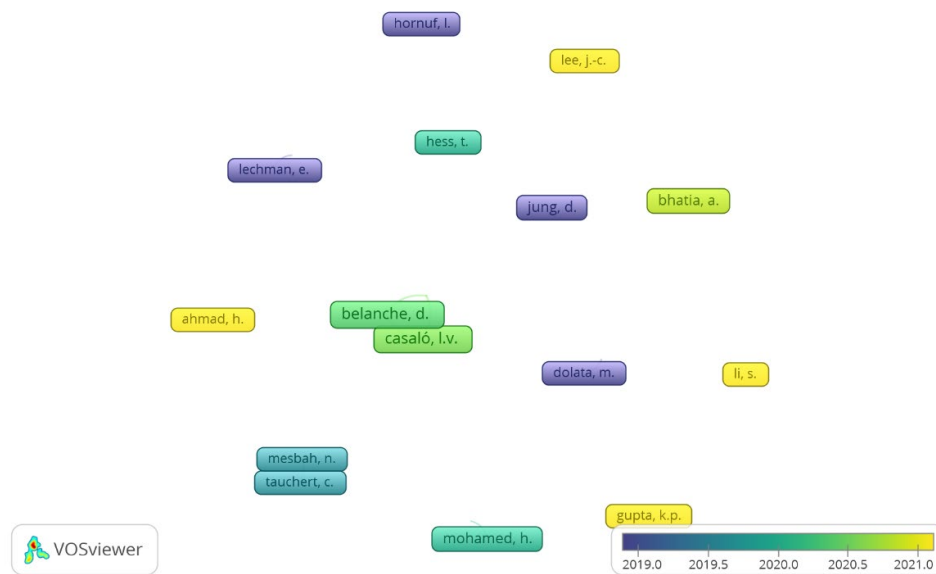


Fig. 5: Citations of the documents. Source: Scopus, elaborated in VOSviewer

4.2.2. Most Used Popular Keyword

The most commonly used words by the journal authors are presented in Figure 6. The term "artificial intelligence" was the most frequently used, with a frequency of 51 (12%). Followed by the terms "investment" and "finance", with matching frequencies of 16 and 14 (4% and 3%), respectively. The words "intention use" were not commonly used, but "adoption" was present 3% of the time with a frequency of 13. According to a study of the most commonly used terms, there is room for more academic research in the field of robo-advisors and their intended use and adoption, despite certain interests.

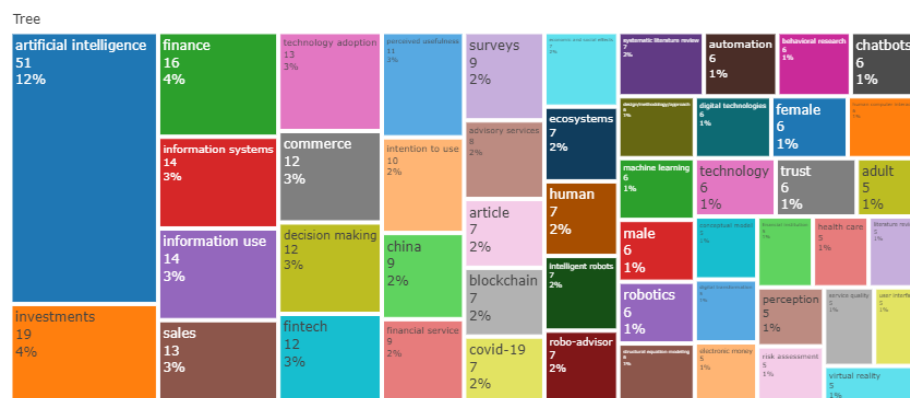


Fig.6: Highest-frequency keyword combinations used by authors

Source: Scopus, created by Biblioshiny

Figure 7 displays the VOSviewer map of the weighted occurrence of authors' keywords, with 3 clusters. The most frequently used keywords by authors in cluster 1 are "fintech", "robo advisor", and "challenge". The terms "factor," "originality value," and "user" dominate cluster 2, and cluster 3 includes "theory," "intention," "usefulness," and "perception". The map's color scheme allows the authors to track how popular words are over time. Thus, we can see that words such as "regulation" and

"challenge" were popular prior to the year 2020, but since then, "perception," "trust," "intention," "usefulness," and "theory" have gained popularity. This trend may be due to regulatory sanctions and the use of such terms in the industry, so it is of interest to academicians to investigate the users' intention regarding trust, perception, and utility and the theory used as a foundation for this topic.

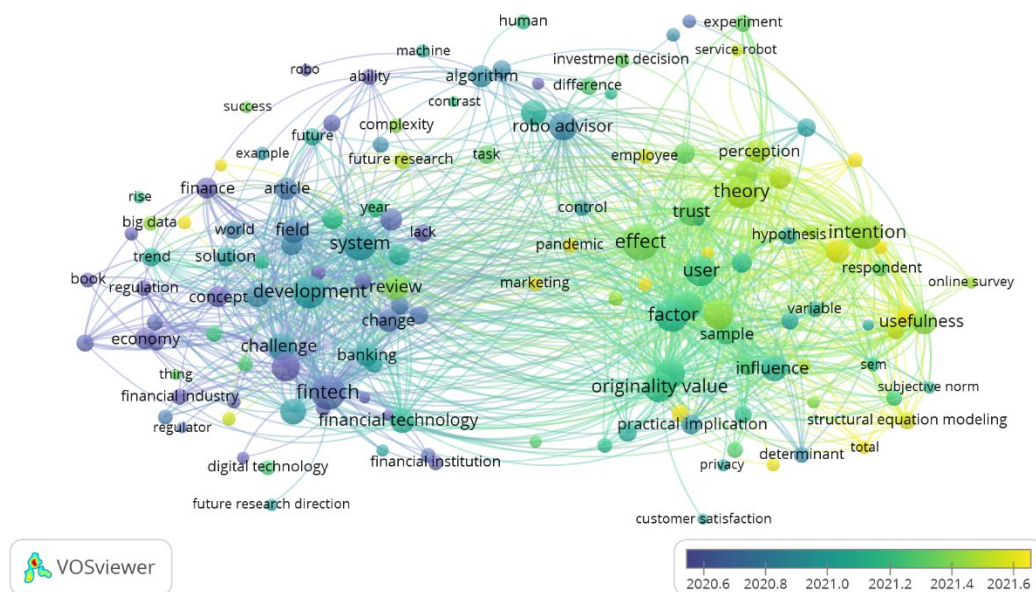


Fig. 7: Weight occurrences of words. Source: Scopus, created in Vosviewer

4.2.3. Most Trending Topics Regarding Robo-advisors and its Adoption

Using Biblioshiny, we can also see what trending topic is related to robo-advisors and its adoption (Figure 8). In 2019-2020, the trending topics "information systems", "finance", and "information use" were frequently used to explain about robo-advisors. Between 2020 and 2022, the trending topics shifted to "investment" and "advisory". This shift is because robo-advisors are financial advisory services based on artificial intelligence. In 2022, "technology adoption" and "trust" were trending, which suggests that the use of robo-advisors is threatening investor confidence as the service delegates investment decisions to non-humans.

Figure 9 shows how often the ten most-used keywords related to the topic of robo-advisors and its adoption is used each year. The words "artificial intelligence" has become the top word since 2016. Next, the words "investment" and "finance" occupy a growing position as words used in recent research.

Figure 10 is a thematic map of the keywords' conceptual structure. The Biblioshiny analysis has identified multiple themes using a network keyword clustering algorithm. First, the map's centrality indicates the motif's importance. Second, density defines the theme's level of development. Based on the analysis, the clusters "artificial intelligence", "finance", "user interface", and "investment" defines robo-advisors' central theme. Its significance necessitates further development. The phrase "technology adoption" is followed by a motor theme, which is also an essential theme to investigate.

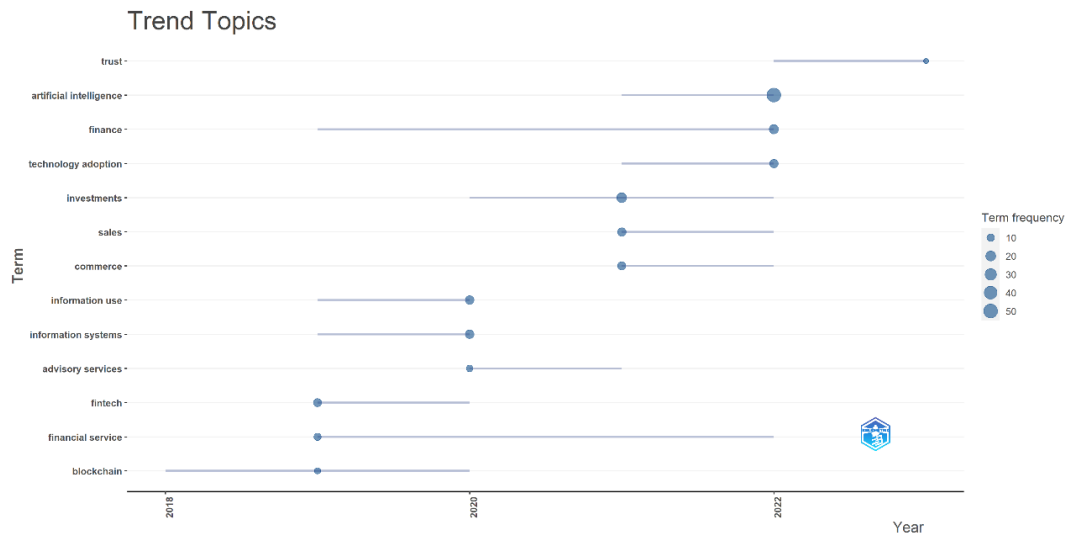


Fig. 8: Trend topics created in Biblioshiny
Source: Scopus

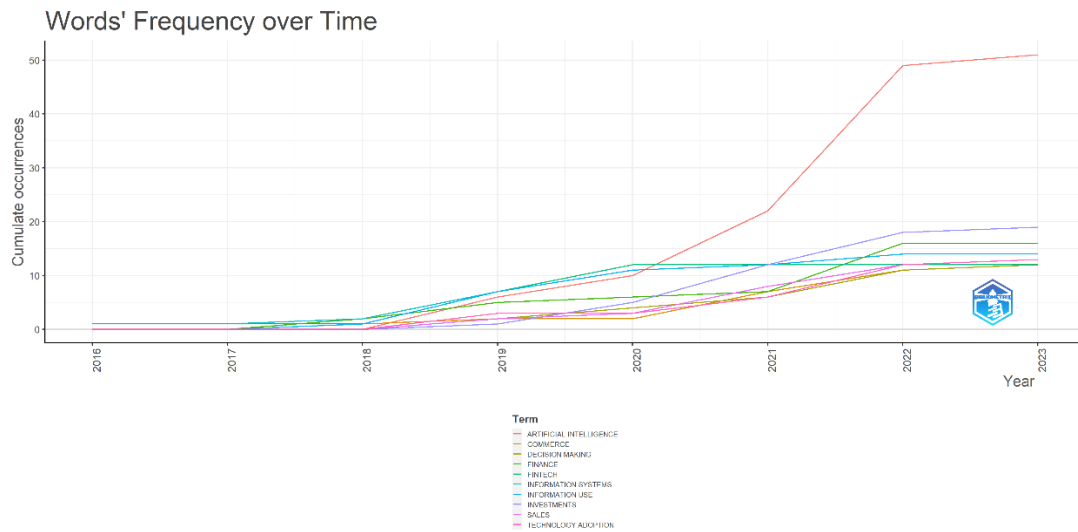


Fig. 9: Word growth
Source: Scopus, created in Biblioshiny

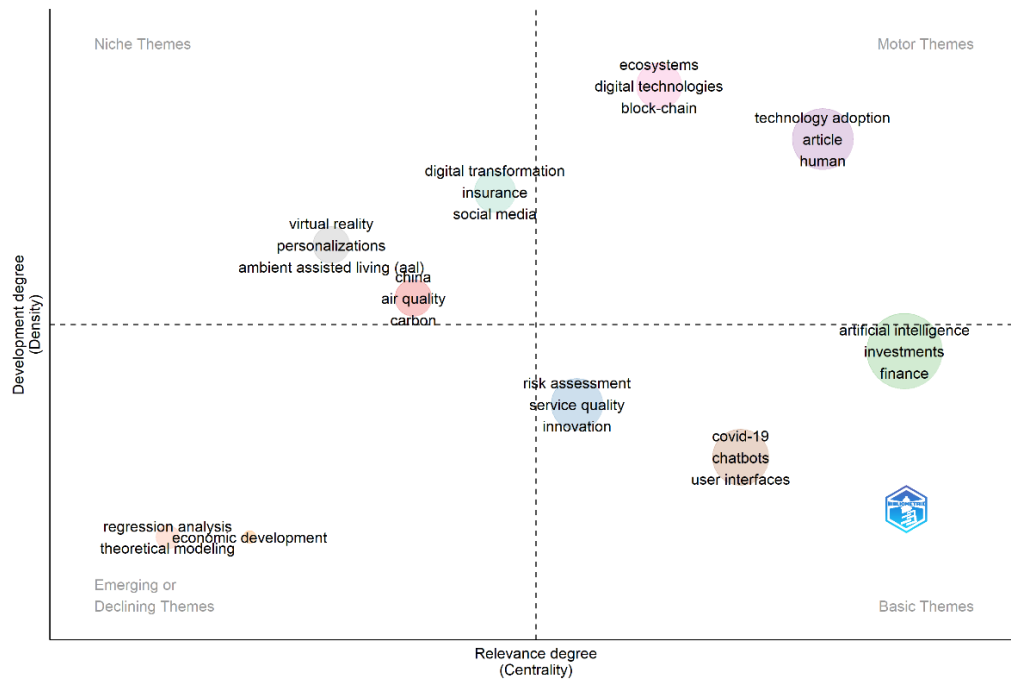


Fig. 10: Thematic map

Source: Scopus, analysis in Biblioshiny

4.3. Author Analysis

4.3.1. The Most Productive Authors

Figure 11 depicts the results of a bibliometric analysis of authors who have published articles on robo-advisors and its adoption. Belanche, D; Casalo, L.V; and Flavian, C are the most productive authors. They are the most cited authors for the paper entitled “Service robot implementation: a theoretical framework and research agenda”, with 191 citations. Belanche, D consistently produces papers focusing on robots and fintech, with one paper in 2019, three in 2020, and one in 2021. Next, Bhatia, A & Chandani, A produced a paper in 2020 with the title “Robo advisory and its potential in addressing the behavioral biases of investors — A qualitative study in Indian context”, which received 32 citations and “Artificial intelligence in financial services: a qualitative research to discover robo-advisory services” in 2021, with three citations. These results suggest that the topic needs to be further explored in some countries, such as India, as an emerging country in the field of robo-advisors.

Table 4: Authors’ publication production

Subject Area	Number of Documents
Belanche, D	6
Casalo, L. V	6
Flavian, C	6
Bhatia, A	4
Chandani, A	4
Jung, D	4
Mohamed, H	4
Ahmad, H	3
Ali, H	3
Dolata, M	3
Gupta, K.P	3
Hess, T	3

Hornuf, L	3
Lechman, E	3
Lee, J. C.	3
Marszk, A	3
Mesbah, N	3
Schwabe, G	3
Tauchert, C	3
Others	<2

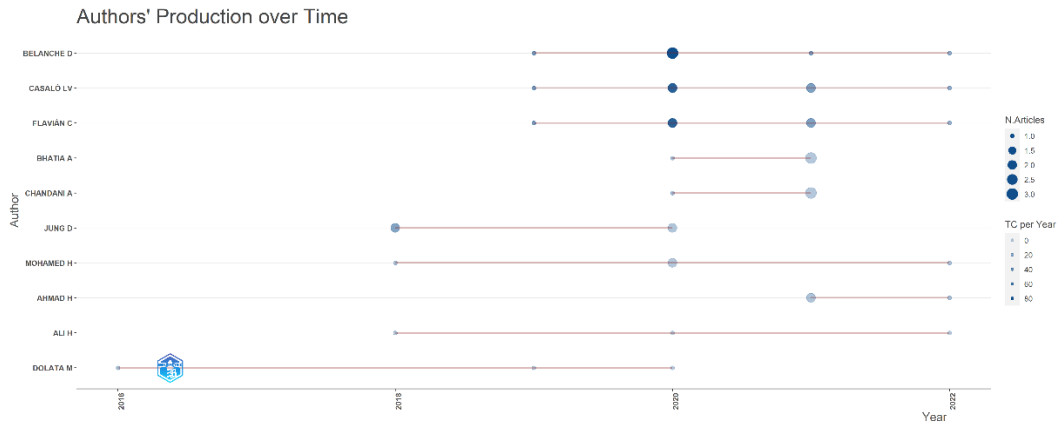


Fig. 11: Paper production by Author
Source: scopus created in Biblioshiny

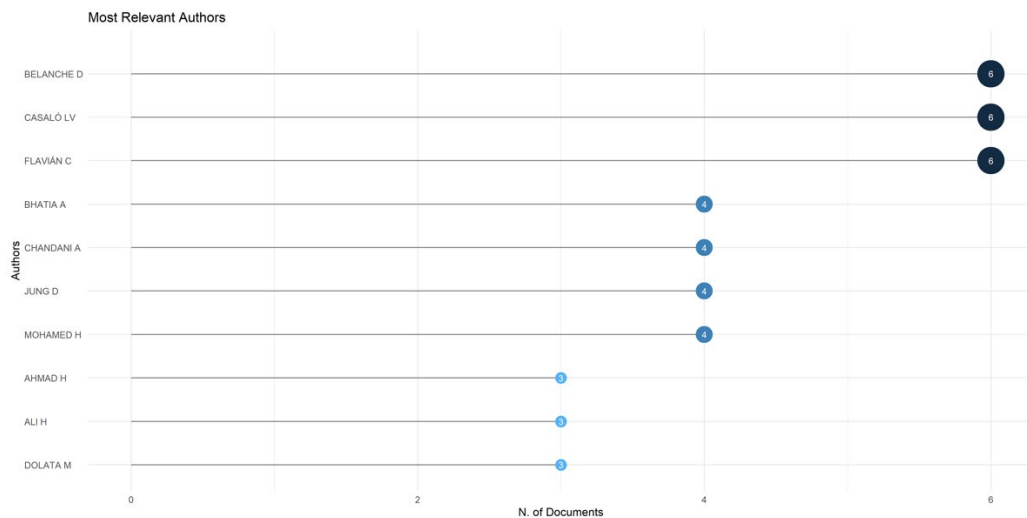


Fig. 12: Most relevant authors
Source: Scopus, created in Biblioshiny

Figure 13 lists the top ten most cited countries for publications on robo-advisors and its adoption. Germany had the most citations, with 841, followed by the United States with 574, and Spain with 401. The data also indicate that most of the research on this topic has been conducted in Europe (Germany, the United Kingdom, Spain, the Netherlands, Portugal, and Switzerland) and the United States (USA, Brazil). Meanwhile, in Asia, China and India represent a small minority.

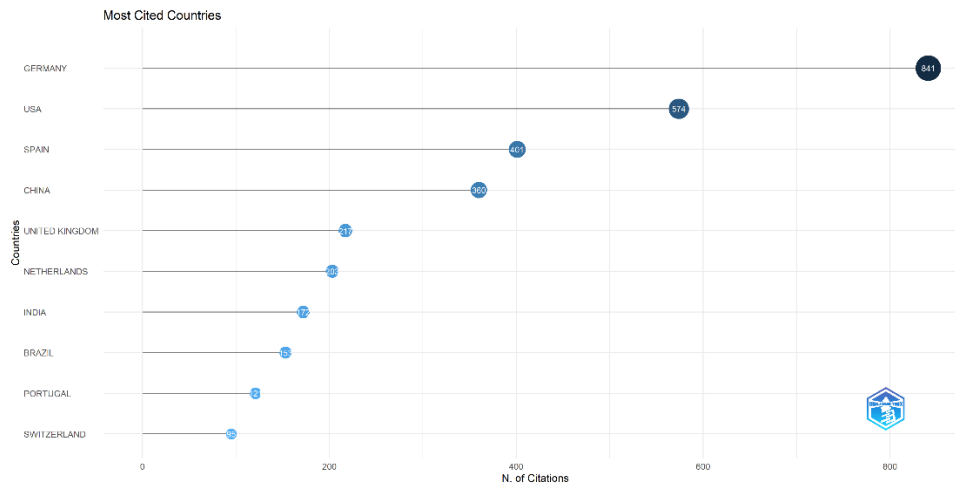


Fig. 13: Most Cited Countries
Source: Scopus, created in Biblioshiny

4.3.2. Authors' H-Index

Figure 14 exhibits the authors' impacts by H-Index, which combines the authors' productivity with citation impact. Belanche, D, Casalo, L.V, and Flavian, D have the highest H-Indexes at 6. In this analysis, the H-Index was only defined for the topic of robo-advisors and its adoption and not for the authors' aggregate H-Index. For example, Belanche, D's overall H-Index is 4.614, Casalo, L. V's is 11.655, and Flavian, D's is 22.977.

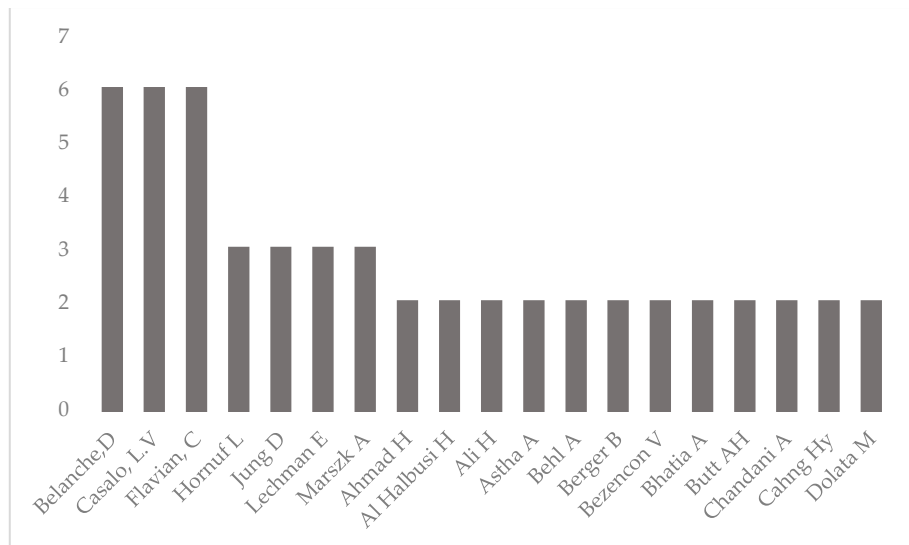


Fig.14: Authors' impact (H-Index)
Source: Scopus, created in Excel

Figure 15 depicts the most influential authors' activities during the specified period. The dimension of the sphere represents the number of annual distributions, whereas the color gradient indicates the number of annual citations. The large bubbles with brighter colors (a high annual distribution with few citations) and small bubbles with darker colors (a low annual distribution with high citations) indicate that annual distribution does not correlate with the number of annual citations. Belanche, D., Casalo, L.V., and Flavian, C produced the most documents, total citations, and citation counts. Followed by Jung, D were Dolata, M and Bhatia, A.

Table 5: Top 10 Authors Based on Production and Citations

Authors	Document	Total Citation	TC/year
Belanche, D	6	561	144.9
Casalo, LV	6	528	138.1
Flavian, C	6	528	138.1
Jung, D	4	163	28.2
Dolata, M	3	66	8.7
Bhatia, A	4	36	9.3
Chandani, A	4	36	9.3
Mohamed, H	4	24	4.3
Ali, H	3	22	3.8
Ahmad, H	3	13	4.5

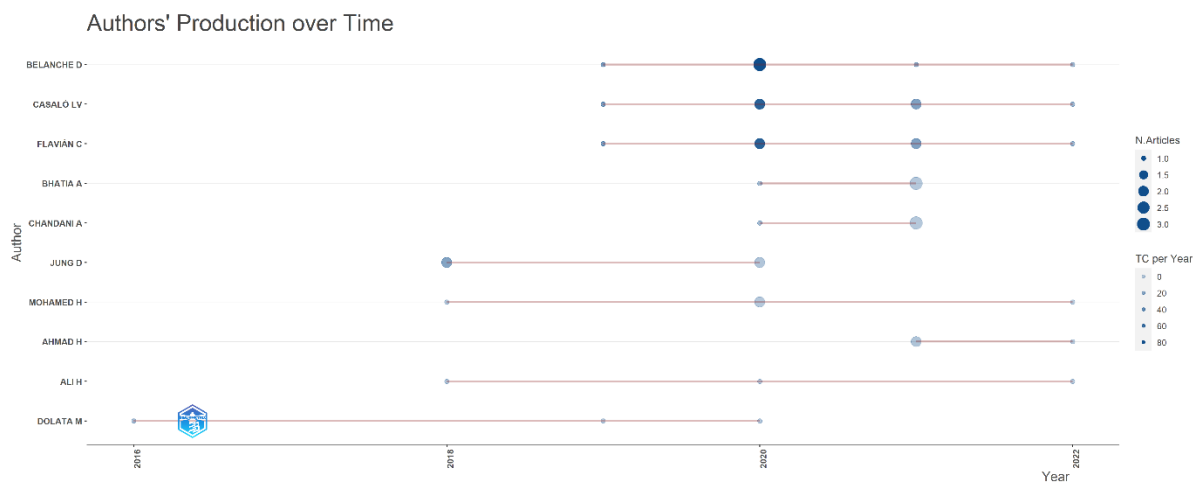


Fig. 15: Production over time by Author

Source: Scopus, created in Biblioshiny

4.3.3. Author and Co-Authorship

Figure 16 demonstrates the mapping of co-authorship by VOSviewer's. As many as 13 co-authors have limited co-authorships. Belanche, D has published six documents with two authors. Overall, co-authorship has only started growing because this topic is new. Moreover, most of the research produced only explains existing robo-advisors, and few use a quantitative method. The discussion section of this paper will summarize some of the methods used by researchers to understand and provide direction for future research on robo-advisors and its adoption.

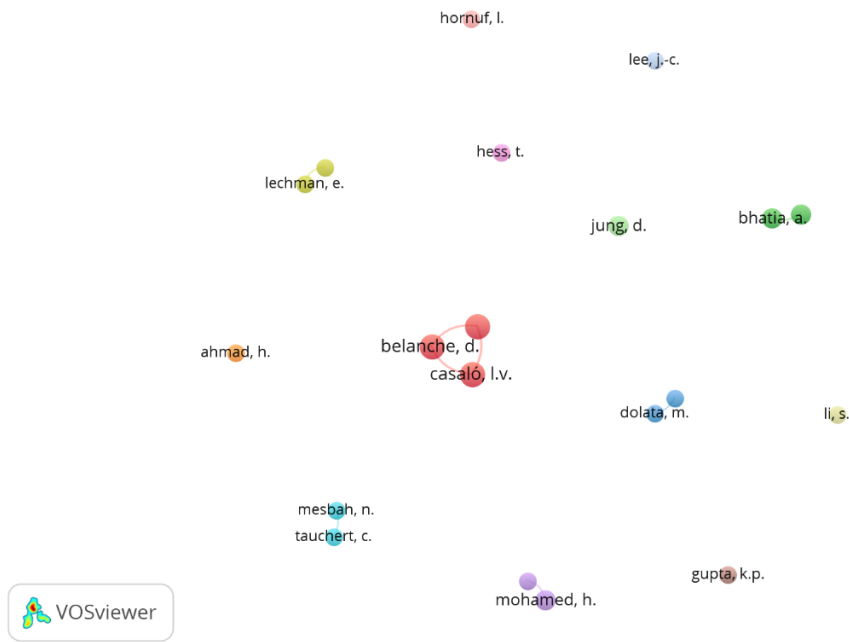


Fig. 16: Author and Co-authorships
Source: Scopus, created in Vosviewer

4.3.4. Authors' Affiliation

The most productive authors were associated with the University of Zaragoza (8 documents) and Symbiosis International (Deemed University), Universidad de Zaragoza, University of Porto, and the University of Zurich (5 documents). The remaining universities on the list have four documents each. Based on the statistics, we can conclude that the authors of this research topic are affiliated with several universities in Europe, the United States, and Asia.

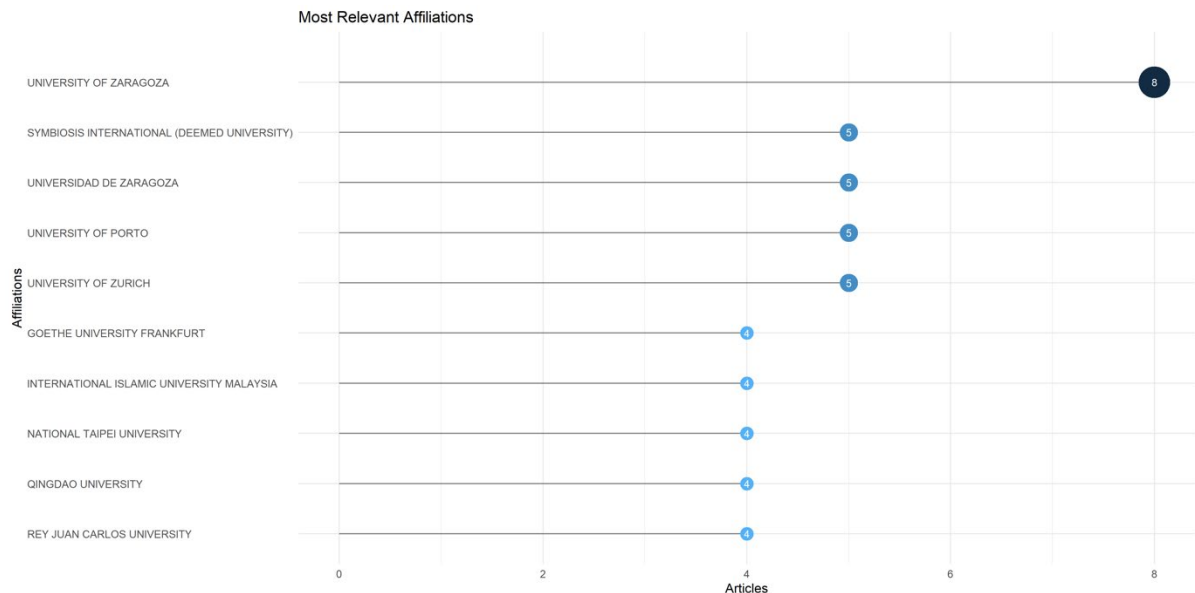


Fig. 17: Authors' affiliation. Source: Scopus, created in Biblioshiny

4.3.5. Publication by Countries

According to Figure 18, Germany has published 54 documents on this subject, followed by China (51

documents), the United States (40 documents), and India (38 documents). Figure 19 depicts Multiple Countries Publications (MCP), which shows the number of papers with at least one co-author from a different country. Authors from China have the most collaborations, followed by the United States and the United Kingdom. Meanwhile, only Indonesian researchers have written papers in collaboration with local writers.

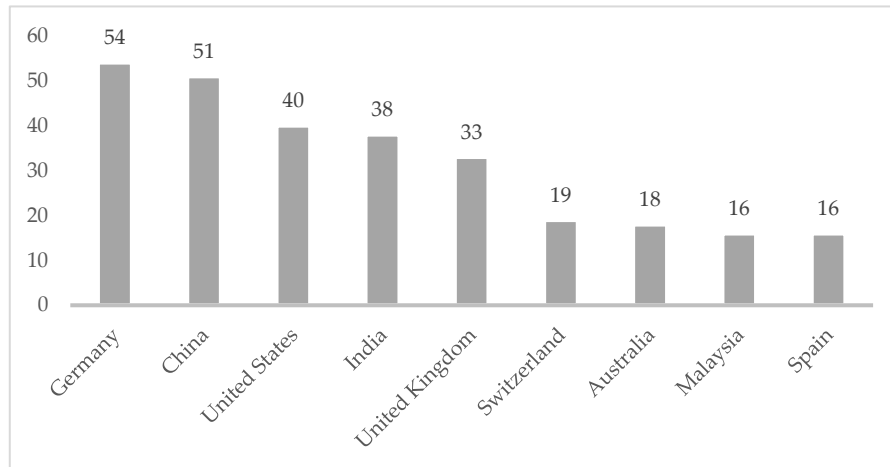


Fig. 18: Countries of publication
Source: Scopus, created in excel

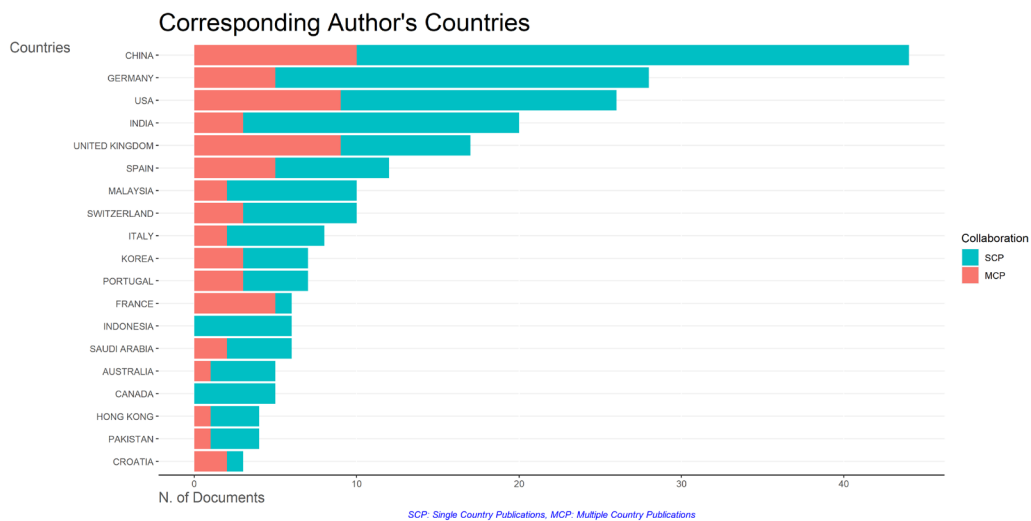


Fig. 19: Countries of Corresponding Authors
Source: Scopus, created in Biblioshiny

4.3.6. Papers that Focus on the Topic

In this section, this research will summarize the selection of papers that focus on robo-advisors specifically in their research. Of the 383 documents, 21 papers were found in the management, business, and economics fields. These papers used different theories and methods in their studies.

Table 6: Summarized Theory, Method, and Country by Authors

Author	Theory	Method	Country
Jung et al. 2018	N/A	Qualitative	Germany
Bruckes et al. 2019	New Construct	Quantitative	Germany
Rühr, et al. 2019	UTAUT	Quantitative	Germany
Belanche, et al. 2019	TAM	Quantitative	Spain

Bhatia, et al. 2020	N/A	Qualitative	India
Lourenço, et al. 2020	New Construct	Quantitative	Portugal
Niszczoła and Kaszás 2020	New Construct	Quantitative	Switzerland
Fan and Chatterjee 2020	New Construct	Quantitative	USA
Noonpakdee, 2020	New Construct	Quantitative	Thailand
Cheng, 2021	ECM	Quantitative	Taiwan
Gan, et al. 2021	UTAUT	Quantitative	Malaysia
Seiler and Fanenbruck 2021	TAM	Quantitative	Germany
Bhatia, et al. 2021	N/A	Qualitative	India
Atwal and Bryson, 2021	TAM	Qualitative	Germany
Wu and Gao, 2021	New Construct	Quantitative	Japan
Bhatia, et al. 2022	Prospect Theory	Quantitative	India
Piehlmaier, 2022	DOO	Quantitative	UK
Y.-C. Ku and Wang 2022	TAM	Quantitative	Taiwan
Figà, et al. 2022	TAM	Quantitative	Italy
Yeh et al. 2022	UTAUT	Quantitative	Taiwan

5. Discussion & Conclusion

We conducted a bibliographic analysis of 383 Scopus-identified documents about robo-advisors and its adoption. According to the results, the topic has only been published between 2016 and February 2022. The primary conclusion of the analysis is that the presented topic is relatively new and has substantial growth potential. These observations and some additional findings are discussed in this section.

To begin, in 2016, research on robo-advisors started to be developed based on new data from the research conducted by Zavolokina et al., (2016), which explains the general context of fintech and briefly mentions that robo-advisors are a form of financial innovation. In 2017, Gomber et al., (2017) explored digital finance and fintech and mentioned that robo-advisors are an innovation in digital finance. Furthermore, Jung specifically researched this topic in 2018 titled "Robo-Advisory: Digitalization and Automation of Financial Advisory". His research has become a reference in developing the topic of robo-advisors to date for the empirical method used. Studies by Bruckes et al., (2019) and Rühr et al., (2019) also used the TAM theory and UTAUT by D Belanche et al., (2019) in their research. Moreover, A Bhatia et al., (2020) conducted qualitative research on the importance of robo-advisors from the provider and user side. This research is followed by quantitative studies with several new constructs by Lourenço et al., (2020), Niszczoła & Kaszás (2020), Fan & Chatterjee,(2020), and W. Noonpakdee (2020).

Based on the analysis, the most popular keywords for the robo-advisor and its adoption topic are "artificial intelligence" and "investment". The popularity of these keywords may be caused by the authors' interest in studying robo-advisors, specifically in finance and investment. Several theoretical bases besides TAM and UTAUT for robo-advisors have also been explored, as shown in research conducted by Ankita Bhatia et al., (2022) regarding investment decisions using robo-advisors based on the prospect theory and Piehlmaier's (2022) use of DIT (Diffusion Innovation Theory) and DOO (Divergent of Opinion).

To date, researchers who have had a great influence on the topic of robo-advisors are Belanche, D, Casalo, L.V, and Flavian, C. There are six documents published on this topic with an H-index of 6 and above 500 citations. The affiliations of the three researchers are still in the same institution, the University of Zaragoza, Germany. As Germany is at the forefront of many technological innovations, including artificial intelligence, it may be a factor in the large amount of research on innovations and robo-advisors.

However, the number of research collaborations still tends to be small and has only been through the same university affiliations. This low number may be caused by the limited number of studies on

robo-advisors and its adoption and relatively new implementation in developing countries.

This research provides an overview of the potential variables that influence robo-advisors' adoption intentions that do not only refer to the technology acceptance model (TAM) theory. For example, the perceived usefulness and perceived ease of use variables have been used in several technology intentions to adopt digital banking (Oktavia et al., 2023) and robo-advisors (Glyn Atwal & Bryson, 2021; Volker Seiler & Fanenbruck, 2021; Yi-Cheng Ku & Wang, 2022). However, the results of the bibliometric analysis show the need to explore several other variables, such as trust, perception, privacy, usefulness, subjective norms, and the algorithms provided by robo-advisor platform providers.

In addition, this research provides direction for the financial industry in general and wealth management in particular, that technological developments can replace the role of individual investment advisors with all the convenience, accessibility, competitive prices, 24-hour service, and reduced bias. The results of this study also provide direction for the wealth management industry to pay attention to matters that influence the intention to replace robo-advisors, such as the importance of ease and usefulness of the application, the need for financial literacy, the influence of environmental recommendations, and several psychological factors.

Nevertheless, the scope of this research on robo-advisors may be restricted because this study focuses solely on the use of robo-advisors. It is anticipated that academics and publishers will be interested in the growth of robo-advisors and the increasing effect these advisors will have on the wealth management industry. Future studies may include more observations to evaluate the veracity of the findings presented in this article and present the patterns and emerging trends in the fields of technology and human behavior.

The findings discussed in this article provide a synopsis of the subject of robo-advisors and the utilization of their services. The authors of this article aim to stimulate additional interest in the subject matter and further investigation on the subject through the publication of this article. The economic and social effects of robo-advisors as an alternative investment method in individuals' financial behaviors and the post-adoption period are particularly promising areas for future research.

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