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Bibliometric Analysis of Investment Portfolio Research Based on Web of Science

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Abstract

To better sort out the development context and research hotspots of investment portfolios, articles use bibliometrics and knowledge graph analysis methods, based on the Web of Science database, to analyze 9069 investment portfolio-related documents from 2007 to 2022. The research results show that: 1) Through bibliometric analysis, it is concluded that the number of publications in the portfolio shows an exponential upward trend, a core author group has been formed among the research authors, and the quality of the source journals is high, most of which are JCR Region 1, and the literature source regions are The United States and China account for 64.866%. The research directions in the literature mainly focus on corporate economics, mathematics, and computers. 2) Through the analysis of investment portfolio research hotspots and frontiers, it is concluded that the investment portfolio covers a wide range. Still, stocks are the research hotspots and frontiers of the investment portfolio.

Keywords

Bibliometric Analysis, Web of Science, Investment Portfolio

1. Introduction

Since the development of the economy, the issue of portfolio selection has become a hot topic in the field of finance. An investment portfolio refers to investors or financial and other investment institutions investing their assets in products with different risks and returns. By hedging risks, the total risk of the investment portfolio rather than the risk of a single investment can be effectively reduced (Tao & Gupta, 2022). The purpose of investment is to obtain returns. Every risk-averse investor must obtain as many returns as possible while considering risks. Because investors have different tolerances for risk, they will have

different asset portfolios. For example, the combination of risky and risk-free assets can obtain certain returns and resist risks. In a combination of two risky assets, if the correlation between the two assets is low, the return from the combination may be greater than the return from individual investments. Therefore, an effective combination of risky assets can effectively avoid risks and make Investor income.

Various theories involved in investment portfolios, which can be traced back to the portfolio theory proposed by Markowitz (1952). This theory is a classic theory of investment portfolios and laid the foundation for the study of modern investment portfolio issues. Later, many scholars conducted further research on investment portfolios based on Markowitz (Markowitz, 1952, 1959). Tobin (1958) supplemented the shortcomings of Markowitz's theory. He proposed the asset portfolio selection theory in 1958, incorporating risk-free assets into Markowitz's theory and believing that the investment proportion of risky assets occupies an essential position in the entire investment. Based on Markowitz, Sharp (1964) proposed the CAPM model in 1964 and divided the risks investments faced into systematic and unsystematic risks, and combined with practice to optimize and improve the model, finally making the model an equilibrium model of the securities market (Saâdaoui & Messaoud, 2020). Vo et al. (2019) believe a good investment portfolio should comprehensively consider the company's environment, society, and governance. In response to the shortcomings of traditional investments, he introduced the Deeply Responsible Investment Portfolio (DRIP) model to predict stock returns and construct socially responsible investments—a combination to achieve better social impact. Corsaro et al. (2021) proposed a multi-period portfolio problem model based on the Fused Lasso method. The Lasso model was critical in reducing dimensionality and sparse selection. Tao and Gupta (2022) selected 11 stocks from 5 representative industries to study the investment portfolio based on the portfolio theory proposed by Markowitz. The results showed that the optimal portfolio had the largest Sharpe ratio and the smallest variance. Moreover, through backtesting, we found that the return rate of the portfolio is between 29% - 40%. To reduce the risk of asset securitization, Deng et al. (2021) used a variety of methods to measure investment risks and returns, applied blockchain technology to jade asset portfolios, and based on the shortcomings of the traditional Artificial Bee Colony (ABC) algorithm, improved ABC algorithm used to blockchain portfolio optimization and to ensure a balance between returns and risks. Zhang et al. (2022) constructed a portfolio optimization model based on risk conditions and evaluated the optimal portfolio strategy of power companies. The optimal investment is analyzed under four policy scenarios. The four scenarios are different expected investment values, phasing out subsidies, tightening carbon emission reduction standards, and different initial renewable energy certificate prices. The research results have a significant impact on enterprises' investment results and the government's optimization policies. Zhou et al. (2022) believe that in the financial industry, studying multi-objective portfolio optimization is of great significance

for obtaining reasonable investment strategies. Therefore, he designed a financial investment portfolio solution based on the multi-objective optimization algorithm based on the NSGA-II algorithm framework and applied it in examples to obtain the effectiveness of the combination plan, expanding the application of modern financial theory. Tsaur et al. (2021) proposed a fuzzy portfolio model to improve the possible mean and variance values by introducing a new fuzzy return function that considers overinvestment in some securities based on a selected guaranteed rate of return, thereby modifying the fuzzy portfolio model. Dai et al. (2020) proposed a ranking-based digital currency investment strategy framework for investment portfolios in the digital currency market. The framework mainly involves selecting digital currency attributes, preprocessing historical data, deriving ranking models for portfolio strategies, and parameter optimization. Luo (2020) proposed a portfolio prediction model based on the Bayesian game algorithm to improve the accuracy of related analysis models in portfolio applications. Yu and Liu (2021) proposed a personalized portfolio recommendation model, using the average-CVaR optimization model to find the best-personalized portfolio, which can be constructed based on the investor's risk tolerance investment portfolio.

Through literature review, it can be found that the investment portfolio theory originated earlier. Scholars' research on investment portfolios mainly focuses on the application of the stock market and mostly uses mathematical algorithm auxiliary tools. There are fewer reviews of the portfolio-related literature. Modern investment portfolio theory mainly consists of investment portfolio theory, capital asset pricing model, APT model, efficient market theory, and behavioral finance theory. Their development has dramatically changed the traditional investment management practice that mainly relied on fundamental analysis in the past, making modern investment management increasingly develop in a systematic, scientific, and combined direction. By 1980, the edifice of classical investment theory had been completed, and no breakthrough progress had been made in the research on the operating rules of the securities market. So this article uses quantitative methods to sort out the portfolio literature, trying to clarify the development trends and context of investment portfolios and detail the research hotspots and future research directions of investment portfolios. Moreover, provide a reference for subsequent scholars' research.

2. Research Methods and Sources

This article uses bibliometrics and knowledge mapping to study the literature related to investment portfolios. First, the subject words are used for a bibliometric analysis of the relevant literature. Secondly, the retrieved literature is analyzed regarding the number of publications, research authors, research directions, and sources. Bibliometric analysis was conducted on country/region, literature source, etc. Finally, software such as CiteSpace and VOSViewer are used to analyze and grasp keyword co-occurrence and research frontiers. And understand the trends and frontiers of investment portfolio development to provide a

reference for future scholars' research.

The literature of this article comes from the Web of Science database and is searched with the subject word "investment portfolio." The search time is as of December 31, 2022. The Web of Science database has a wide range of high-quality collections. It is an essential tool for scholars to research literature and is well-representative.

3. Bibliometric Analysis

3.1. Statistics of Published Articles

Publication volume statistics can reveal the number and trends of literature research in a certain field and are a commonly used statistical method in quantitative analysis. In the Web of Science, select the Web of Science core set of documents and search with the subject word "investment portfolio." A total of 9304 documents were retrieved. The search time is as of July 4, 2023. A total of 9069 documents from 2007 to 2022 were counted, as shown in Figure 1. It can be seen from the figure that the earliest research time for the literature on investment portfolios was in 2007. As time goes by, the research trend shows an overall upward trend, with a more significant increase between 2007 and 2019, then stabilizing after 2019. The amount of relevant literature is expected to stabilize throughout 2023. After fitting the development trend of the number of documents over the years, R square = 0.8925 was obtained, so it can be concluded that the fitting effect of the portfolio documents is good. Since 2008, the distance between the actual and theoretical values of the cumulative number of documents has increased yearly, indicating that current portfolio research has matured more after 2008.

3.2. Analysis by Study Authors

Table 1 counts the relevant authors on investment portfolios from 2007 to 2022. It can be seen that the author who wrote the most has written 63 articles. According to Price's law (Sun, 2021), $m = 0.749\sqrt{n_{\max}}$, Among them, m represents the lowest number of publications among the determined core authors, and $n_{\max}$ represents the author with the highest number of publications in a certain field.

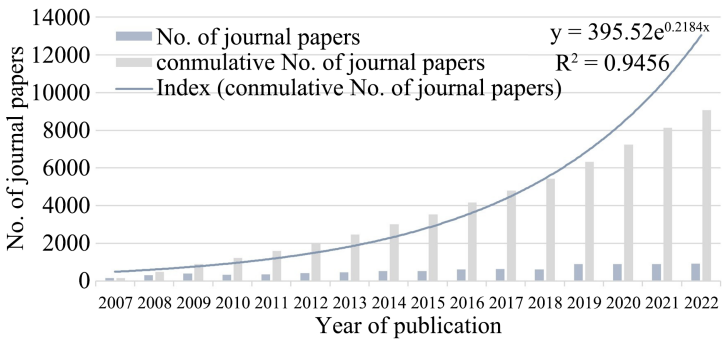

Figure 1. Number of portfolio research documents based on Web of Science (WOS). Data source: Literature statistics of WOS platform.

Table 1. Portfolio author statistics.

Authors	Record Count	Percentage	Authors	Record Count	Percentage
Li X	61	0.673	Li J	35	0.386
Zhang Y	53	0.584	Huang Xx	32	0.353
Li Y	52	0.573	Shin Yh	30	0.331
Wang Y	51	0.562	Wang H	30	0.331
Wang J	49	0.540	Chen W	29	0.320
Zhang X	42	0.463	Siu Tk	29	0.320
Liu Y	40	0.441	Zeng Y	28	0.309
Li D	39	0.430	Chen L	27	0.298
Li Zf	39	0.430	Li B	27	0.298
Chen Y	38	0.419	Liu J	27	0.298
Zhang Wg	38	0.419	Wong Hy	27	0.298
Li Z	36	0.397	Chen Z	26	0.287

In the portfolio study, the author with the most publications is Li X, so n_{max} is 63, and $n = 5.8498$ can be determined. It is approximately equal to 6, so 6 is used as the cut-off value to classify core authors, and a total of 50 core authors in the portfolio field are considered. Since there are many core authors, this article only counts 24 core authors who have published more than 26 articles.

3.3. Literature Research Direction and Source Country Analysis

3.3.1. Analysis of Literature Research Direction

Table 2 counts the top 25 literature sources. It can be seen from the figure that the top 5 research directions are Business Economics, Mathematics, Computer Science, Engineering, Operations Research Management Science. It can be seen that the investment portfolio's scope is broader, including enterprise economics, mathematics, computers, engineering, etc., but it is mainly concentrated on enterprise economics, accounting for 71.573%. It can be seen from the cumulative percentage in the figure that the percentage is not 1. There is an overlap between research directions. Portfolio-related literature may involve multiple research directions.

3.3.2. Analysis of Literature Source Regions

Figure 2 shows the country's investment portfolio sources. It can be seen from the figure that the first place is PEOPLES R CHINA (People's Republic of China), the second place is USA (United States), and the third place is CHINA (China). The top three alone accounted for 64.866%, accounting for the majority, especially China, which accounted for 44.092 (including the People's Republic of China and China). This shows that China has made a greater contribution

Table 2. Portfolio literature research direction statistics.

Research Direction	Record count	Percentage
Business Economics	6491	71.573
Mathematics	5782	63.756
Computer Science	5494	60.580
Engineering	4070	44.878
Operations Research Management Science	2153	23.740
Energy Fuels	1124	12.394
Mathematical Methods In Social Sciences	1017	11.214
Environmental Sciences Ecology	965	10.641
Automation Control Systems	933	10.288
Science Technology Other Topics	789	8.700
Robotics	664	7.322
Physics	418	4.609
Telecommunications	272	2.999
Geography	248	2.735
Mathematical Computational Biology	246	2.713
Agriculture	237	2.613
Government Law	235	2.591
Social Issues	179	1.974
Meteorology Atmospheric Sciences	178	1.963
Biodiversity Conservation	151	1.665
Health Care Sciences Services	142	1.566
Public Administration	141	1.555
Materials Science	134	1.478
Social Work	133	1.467
Public Environmental Occupational Health	130	1.433

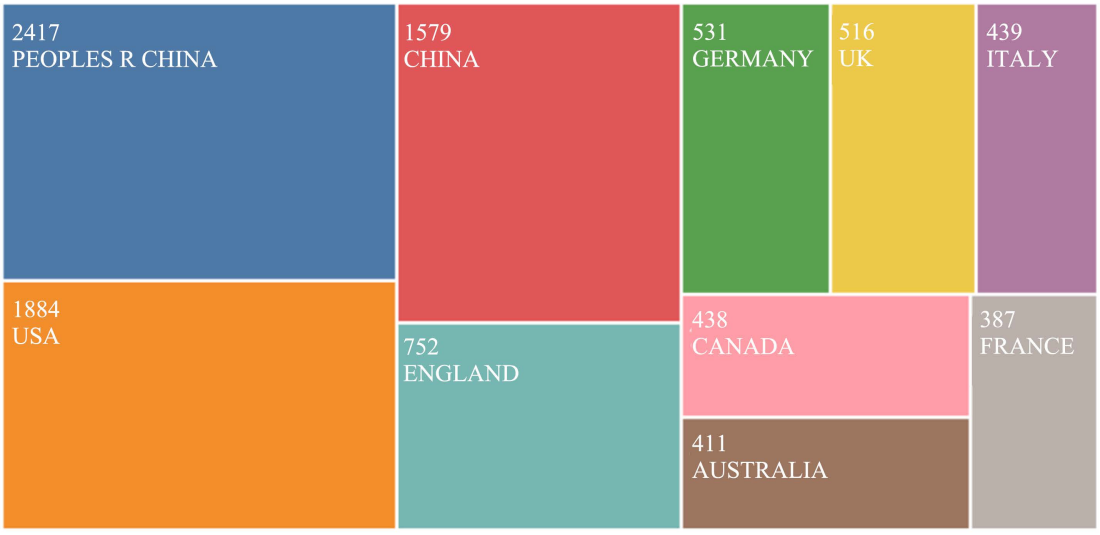

Figure 2. Portfolio source country.

to the literature on investment portfolios. The countries closely followed include England, Germany, the United Kingdom, and Italy, but the literature contributions of these countries are all less than 10%.

3.4. Literature Source Analysis

Table 3 counts the sources of literature on investment portfolios. It can be seen from Table 3 that among the top 20 journals with the largest number of statistics, Q1 accounts for the largest proportion, indicating that the quality of literature on investment portfolio-related research is high. It can be seen from the impact factor that although the Q1 area has a high proportion, the impact factor is not large. This also shows no significant positive correlation between the impact factor and the partition in the JCR partition. The top-ranked magazine "European Journal of Operational Research" contains 377 portfolio-related documents, accounting for 4.157% of the total documents, and belongs to the first area of JCP, with an impact factor of 6.4, which also shows that the quality of the relevant literature on investment portfolios is relatively high.

Table 3. Portfolio literature source statistics.

Publications/Sources	JCR partition	Impact factors in the past 5 years	Record count	Percentage
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH	Q1	6.4	377	4.157
ANNALS OF OPERATIONS RESEARCH	Q3	4.6	219	2.415
EXPERT SYSTEMS WITH APPLICATIONS	Q1	8.3	196	2.161
QUANTITATIVE FINANCE	Q3	1.9	193	2.128
SUSTAINABILITY	Q3	4.0	163	1.797
ENERGY POLICY	Q2	8.5	132	1.456
INSURANCE MATHEMATICS AND ECONOMICS	Q2	2.2	118	1.301
SIAM JOURNAL ON FINANCIAL MATHEMATICS	Q3	1.4	116	1.279
MATHEMATICAL FINANCE	Q2	2.1	103	1.136
MATHEMATICAL PROBLEMS IN ENGINEERING	Q3	1.7	99	1.092
MANAGEMENT SCIENCE	Q1	7.1	81	0.893
APPLIED ENERGY	Q1	11	79	0.871
COMPUTATIONAL ECONOMICS	Q4	1.8	78	0.860
JOURNAL OF INDUSTRIAL AND MANAGEMENT OPTIMIZATION	Q4	1.3	73	0.805
AIP CONFERENCE PROCEEDINGS	Q1	4.1	72	0.794
ENERGY	Q1	8.3	70	0.772
JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS	Q1	2.3	65	0.717
JOURNAL OF CLEANER PRODUCTION	Q1	11	64	0.706
JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY	Q1	3.4	64	0.706
PLOS ONE	Q1	3.8	64	0.706

4. Hotspots in Portfolio Research

4.1. Visual Analysis of Co-Occurring Keywords of Research Topics

Figure 3 shows the keyword co-occurrence map drawn using VOSViewer software. Since the number of researched documents is 9069, which is relatively large when setting the threshold, the threshold value is set to 50; the frequency of occurrence is greater than or equal to 50 before it will appear in the node. The larger the node in the graph, the higher the frequency of occurrence, and the color indicates the category of portfolio-related literature. As can be seen from the graph, it is divided into three categories. The red part includes 184 categories, mainly benefit, development, policy, research, etc., which can be summarized as research policies, development, etc.; the green part includes 115 projects, mainly including keywords such as algorithm, stock, portfolio, theory, etc. related to stocks. The blue part contains 113 keywords, headed by problem, including process, wealth, consumption, and others. Through observation, it is found that from blue to green and then to red, it can correspond to the research orientation of asking questions - analyzing problems - and solving problems (proposing countermeasures and suggestions).

4.2. Keyword Emergence Analysis of Research Topics

Keyword emergence can reveal the development trend of related topics at a specific time, as shown in Figure 4. The red part indicates the year in which the keyword emerged. The closer to the left, the farther the year of emergence, and the closer to the right, the closer the year of emergence. The length of the red part indicates the length of the burst time. The longer the red part, the longer the burst time. The shorter the red part, the shorter the burst time. Figures 2-4 analyzes the emergence of keywords in investment portfolios in the 15 years from 2007 to 2022. Set the threshold r value to 1, and then there are 25 emergent

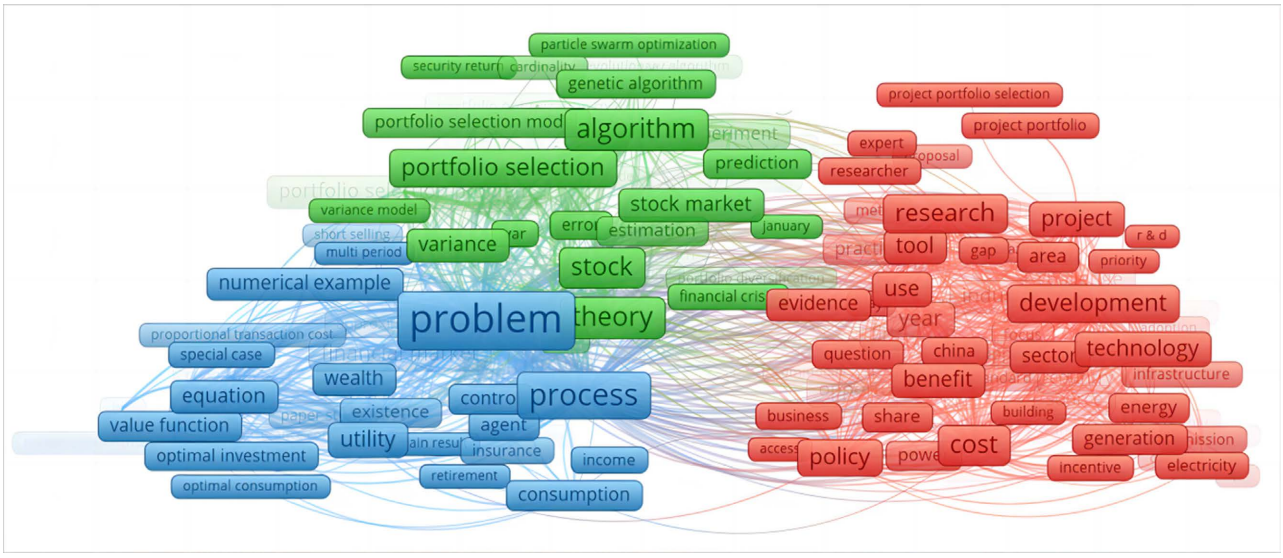

Figure 3. Keyword co-occurrence map in the field of investment portfolio research.

Keywords	Year	Strength	Begin	End	2007-2022
optimalportfolio	2007	6.11	2007	2012	
consumption	2007	4.56	2007	2008	
continuoustimemodel	2007	6.55	2009	2014	
biodiversity	2007	5.73	2009	2015	
stochastic volatility	2007	6.7	2011	2018	
benchmark	2007	4.73	2012	2016	
stability	2007	4.66	2013	2017	
g11	2007	5.67	2014	2017	
optimal investment strategy	2007	4.48	2014	2019	
levy proce	2007	4.47	2014	2015	
flexibility	2007	4.36	2015	2018	
portfoliooptimization	2007	4.86	2016	2018	
portfoliotheory	2007	4.69	2016	2017	
incompletemarket	2007	7.95	2017	2018	
Proportionalreinsurance	2007	4.49	2017	2019	
test	2007	6.14	2019	2022	
machine learning	2007	5.33	2019	2022	
crude oil	2007	4.8	2019	2022	
evolutionalgorithm	2007	4.43	2019	2020	
regime-switching	2007	4.32	2019	2020	
china	2007	7.46	2020	2022	
index	2007	6.31	2020	2022	
stock return	2007	5.05	2020	2022	
stock	2007	4.8	2020	2022	
hedge	2007	4.33	2020	2022	

Figure 4. Portfolio keyword emergence chart.

words with investment portfolio as the subject keyword. The intensity of keyword emergence in the figure differs; the intensity range is 4.36 - 7.95. Among them, the one with the smallest burst intensity is "hedge," which is 4.33. The emergence time is between 2020-2022, which is three years. The one with the highest burst intensity is "incomplete market," with a burst intensity of 7.95. The burst time began in 2017 and ended in 2018. The burst time was short, only two years. The keyword with the longest emergence time is "stochastic volatility," lasting eight years from 2011 to 2018. Keywords whose emergence intensity will continue until 2022 include "test," "machine learning," "crude oil," "stock," "hedge," "index," etc., which also indicate the future development trend of relevant investment portfolios. It can be seen that future development of investment portfolios will be more equity-related.

5. Conclusion

This article uses CiteSpace and VOSViewer to analyze the investment portfolio literature in the Web of Science database. It analyzes and visualizes the number of publications, research authors, research directions, source countries/regions, literature sources, and portfolio research hot spots. The main research results are as follows: 1) Judging from the number of published articles, investment portfolio research has shown an overall upward trend, increasing rapidly from 2017 to 2019 and tending to stabilize after 2019. 2) The scope of investment portfolio re-

search is broad, and the quality of the literature is high, but the main literature comes from China. 3) Research hot spots include benefit, policy, algorithm, stock, portfolio, wealth, consumption, etc., but the key topic in the future will still be stock. 4) From the bibliometric research, it is found that the existing research results have enriched the traditional investment portfolio theory, and the research perspectives and fields have been expanded and developed.

By analyzing and visualizing the results, you can better understand the research dynamics and trends in the portfolio field, and you can also be wary of the following factors: 1) The data used in the research has a lag and may not reflect the latest research dynamics and trends promptly. 2) People have different preferences for risks, and the conclusions drawn may be unfair. Subsequent research still needs to be judged and analyzed based on current affairs. 3) Research hot spots change rapidly, and many areas still require in-depth exploration and exploration. 4) There are differences in policy environments, economic foundations, and market conditions in different regions, which may lead to differences in venture capital activity and investment strategies in different regions.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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