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RESEARCH ARTICLE

BIBLIOMETRIC REVIEW AND CO-CITATION ANALYSIS OF DOCUMENTS PUBLISHED IN THE DERIVATIVE MARKET: A STUDY BASED ON THE SCOPUS DATABASE

Subeesh V.K.[1] and M.A. Joseph[2]

1. Research Scholar, DCMS, University of Calicut.
2. Professor (Retd.), DCMS, University of Calicut.

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Abstract

This article provides a bibliometric study of relevant papers on the derivative market. This study seeks to objectively evaluate research trends in the derivatives market by utilising bibliometric analysis. The direction for future study efforts has also been considered using the themes developed here. The data were collected from the Scopus database using specified search criteria. In-demand writers, publications, organizations, and nations were examined in this study of the derivatives market literature. This study also included co-citation analysis and co-occurrence of keyword analysis to provide a thorough understanding of the bibliographic pattern of literature in the derivative market. In this study,VOS Viewer and Microsoft Excel were used to assess co-authorship, co-occurrence, and citation patterns.The findings indicate that scientific study in this field has expanded quickly, especially after 2004. Fischer Black is the most prominent author in the derivatives market, according to Co-citation analysis, with 316 citations, 307 links, and 7652 total link strength. Other well-known authors in the area include Myron Scholes, Robert E. Whaley, and Doojin Ryu.

Introduction:-

The global "derivative market" grew rapidly over the last ten years. Derivatives provide essential tasks like market efficiency, underlying asset deal price discovery, and risk management through hedging, to name a few. A derivative is a financial instrument that derives its value from an underlying asset (Hull & Basu, 2017). The underlying asset can be equity, currency, commodities, or interest rate. Although derivatives were initially intended to be risk management tools, most users now use them to make speculative gains, thereby increasing their popularity. The daily growth in derivatives trade volume is evidence of the importance of derivatives. Bibliometric papers summarize large quantities of bibliometric data to present the state of the intellectual structure and emerging trends of a research topic or field (Donthu et al., 2021). The objective of this study is to locate and synthesise pertinent literature in the area of derivative markets, to understand recent developments in the field of research, and to provide a strong framework for future studies in this area. The study's objective will be achieved with the help of the subsequent research questions.

1. How has the number of publications on the derivative market changed over time?
2. What changes have occurred in the literature on derivative markets?
3. What have been the most influential researches in the area of derivative markets?

Corresponding Author:- Subeesh V.K.
Address:- Research Scholar, DCMS, University of Calicut.
(Assistant Professor, SARBTM Govt. College, Koyilandy, Kozhikode, Kerala. India. Email: subeeshvk@gmail.com)

4. What are the most important subjects and issues in the derivatives market scholarly literature?

Literature Review:-

Large-scale scientific data can be explored and analysed using the popular and accurate bibliometric analysis technique. It enables us to unpack the evolutionary nuances of a specific field, while shedding light on the emerging areas in that field (Donthu et al., 2021).In the last 40 years, derivatives have become increasingly important in finance. Futures and options are actively traded on many exchanges throughout the world (Hull & Basu, 2017). A derivative is a generic term referring to forwards, futures, options and swaps (S.S.S. Kumar, 2015). Bibliometric evaluations of issues linked to the derivative market have been performed in the past. Stock Market Prediction: The perspective of Emerging Markets was the subject of a bibliometric investigation by Somanathan & Rama, (2020). The research is based on Web of Science, Scopus, and JSTOR databases. The key finding is that the real phenomena affecting stock market sectors are varied and, as a result, generalization is limited. Sankar & Kavitha, (2015) brings out the results of a bibliometric analysis of the journal titled "Journal of Emerging Market Finance". The study focused on the number of articles, authorship patterns, average number of references per article, article length, paper per author and authors per paper, number of cited documents, citation per year, citation per paper and author, and the year-by-year distribution of H index, G index, HG, HI, and AWCR.S. Kumar et al., (2020) present a complete analysis of the Journal of Emerging Market Finance's major trends and theme structure (JEMF). The findings imply that the number of publications and citations every year at JEMF is on the rise. Baker et al., (2021) used bibliometrics to give a 40thanniversary retrospective on the Journal of Futures Markets (JFM). The number of publications and citations in the Journal increased significantly each year, with authors from the United States accounting for the majority of the contributions. Commodities, volatility, trading, hedging, arbitrage and pricing, forecasting volatility, and credit default swaps are among the Journal's key themes, according to bibliographical coupling.Kaur & Goel, (2021) aims to provide a quantitative and thorough summary of research on market efficiency, price discovery, and volatility in commodity futures markets. The researchers employed a combination of bibliometric and network analysis approaches to classify and analyze the literature in order to uncover important patterns and themes in the subject. Based on a bibliometric analysis,Kim & Kim, (2021) investigates the historical evolution of Journal of Derivatives and Quantitative Studies (JDQS) between 2002 and 2020. To examine JDQS's diverse views utilizing the patterns of citations, keywords, and authors in JDQS's articles, the study uses performance analysis, bibliographic analysis, cluster analysis, regression analysis, and comparison analysis. Zulfikar, (2022) conducted a study to analyze the determinants of the research roadmap cluster in the field of capital market performance. The research was based on articles published in Scopus-indexed journals between 2020 and 2021. The results of extracting 240 article titles and abstracts with VOSviewer revealed that the determinants of the research roadmap in the stock market during the COVID-19 out-break were divided into four clusters: 1) an increase in cryptocurrencies such as bitcoin due to the spillover of oil and gold prices; 2) international stock market response and behavior; 3) major stock market performance results such as stock returns and equity; and 4) change in the research roadmap in the stock market.Another study of Choijil et al., (2022) examines 30 years of academic research on herd behaviour in financial markets. The Web of Science database was chosen to collect bibliographic data and give numerous bibliometric indicators, such as the number of citations, publications, and authors, as well as to visualize the similarities using bibliometric approaches. The findings demonstrate a huge increase in herd behaviour studies, particularly in the aftermath of the subprime mortgage crisis.

Thereview of literature on bibliometric analysis related to the financial market reveals that no studies of bibliometric analyses directly relevant to derivative markets have been conducted yet. The derivative market is a diversified market that interacts with a number of products and contains a variety of underlying markets; thus, it is important to look into which sections of the derivative market have more and less study. As a result, the author discovered a gap in the research that served as the impetus for the present study.This study is being conducted to explain the performance, trend and citation patterns of publications in the derivative market literature.

Methodology:-

The data extracted from the Scopus database was used to conduct the analysis for this study. The bibliometric analysis primarily employs three knowledge structures: the conceptual structure, which identifies major themes and trends; the social structure, which explains author, institution, and country interactions; and the intellectual structure, which explains how an author's work influences others (Aria & Cuccurullo, 2017). VOSviewer and Microsoft Excelare used to conduct the network analysis.

Data source

The dataset has been extracted the Scopus database.The following search string was used as part of the search criteria: TITLE-ABS-KEY(equity AND derivatives AND market) OR TITLE-ABS-KEY(futures AND option AND market) AND TITLE-ABS-KEY(hedging) OR TITLE-ABS-KEY(trading)) AND (LIMIT-TO (DOCTYPE,"ar").This search produced 858 items in the Scopus database.As a result of this search, the Scopus database returned 858 results.This resulted in the dataset for doing bibliometric analysis in the area of derivative market.

Results:-

The two parts have discussions of the results.

1. Publication and citation structure: This part analyses publications by eminent authors, journals, institutions, and nations, as well as yearly publication patterns.
2. VOSviewer-based bibliometric analysis:- This part analyses the co-occurrence of keywords and the co-citation analysis of authors.

Annual trends in publication

The trend of publications on the derivative market (Fig. 1) reveals that research in this area has expanded quickly, especially since 2004, accounting for 80.19 percent of all publications between 2005 and 2022. This data reveals a growing interest and development of the area, demonstrating that derivative market represents an important area of research. Figure 1 shows that the number of publications was quite low until 1995 (less than 5 publications a year). The majority of the studies published during this time period are connected to futures and options trading. After 1996, the pattern shifted and the number of publications per year has been increasing since 2004. Since 2005, there has been a substantial growth in derivative market publications.

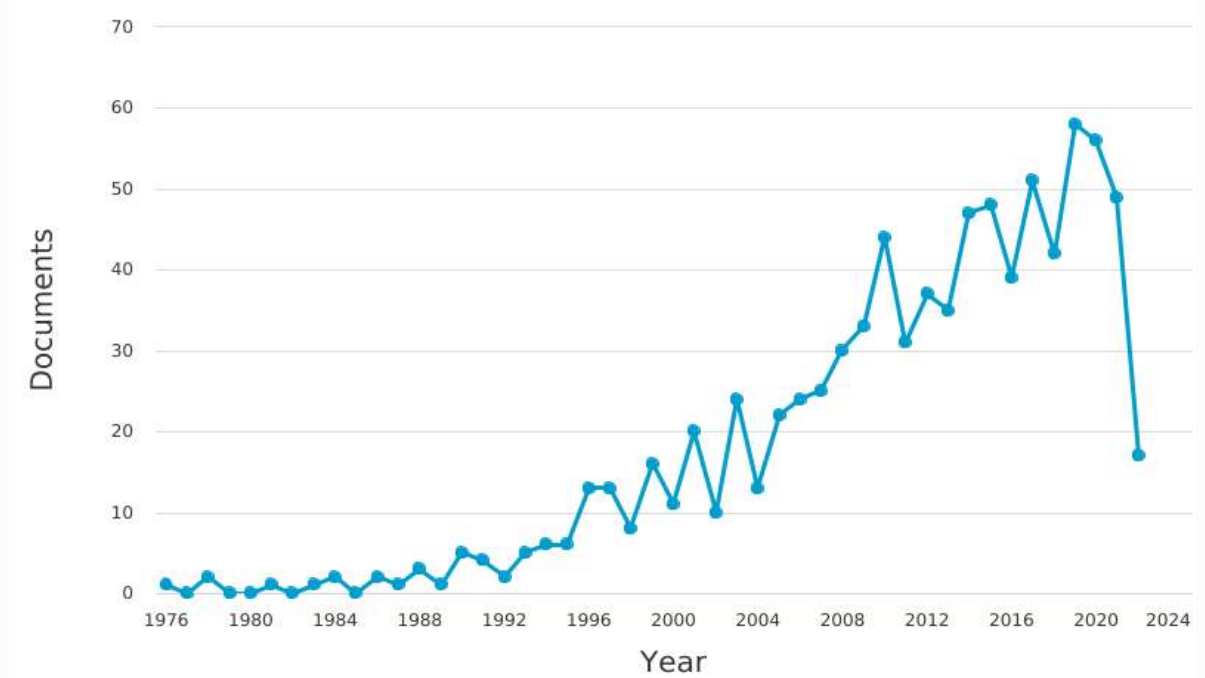

Figure 1:- Annual Number of Publications(Source : https://www.scopus.com/).

25 percent of studies were published during the period between 2000 and 2009, whereas 50 percent of documents published in between 2010 and 2019. The highest number of annual publications in derivative market was happened in the year 2019 with 58 documents. In the current year 2022, 17 documents were published within first three months which indicates that the growing trend in derivative market research is continuing.

Leading authors

Here is a summary of the findings from an examination of eminent authors, organizations, and nations. With 13 publications published in Scopus, Prof. Doojin Ryu of Sungkyunkwan University in Seoul, Korea, is the most

productive author among the authors who have studied the derivative market (Fig. 2). His study mostly concentrates on the futures and options markets. His most recognised work (Ahn & Ryu, 2008) examines whether informed trading is present in the index option market by analyzing the KOSPI 200 options, the most actively traded derivative product in the world. Keith P. Wong, second in list, is the Finance professor of HKU Business School, University of Hong Kong. He has done various research on risk management that examines the issues of how risk-averse firms should hedge their exposure to various sources of uncertainty (e.g., exchange rate risk, price risk, and liquidity risk) in general, and the optimality of using options as a hedging instrument in particular.

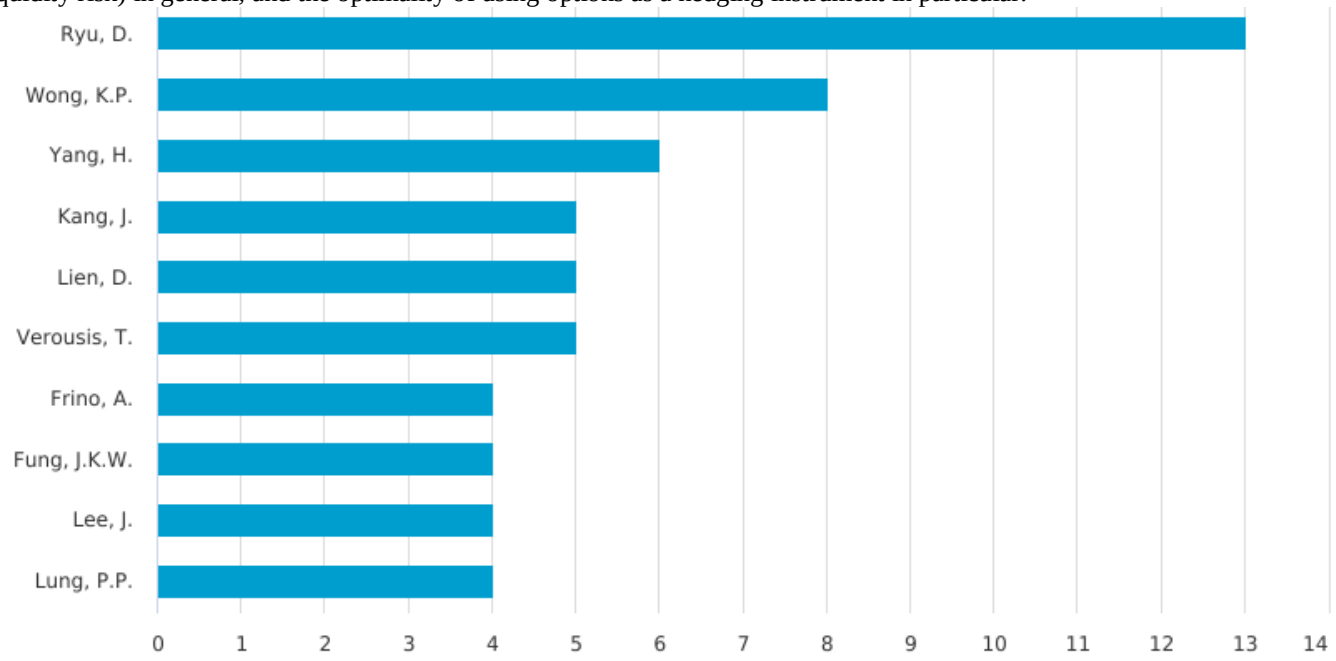

Figure 2:- Number of publications of leading authors(Source : https://www.scopus.com/).

Prof. Heejin Yang is a faculty of College of Management & Economics, Dongguk University Gyeongju, Korea, and all of publications are in associan with Prof. Doojin Ryu.Prof. Jangkoo Kang is at the Graduate School of Finance, KAIST, Seoul, Korea. Prof. Donald Lien a is at department of Economics, University of Texas, USA. Dr. Lien's primary field of interest is in the futures market with supporting areas in econometrics and development economics. Dr Thanos Verousis is Reader in Finance at Essex Business School, University of Essex, Colchester, UK. He specializes in financial markets and market microstructure. Alex Frino is the Deputy Vice-Chancellor (Global Strategy) of the University of Wollongong, Sydney, Australia. A distinguished international financial economist. He is one of the best-published financial economists in the world with over 100 papers in leading scholarly journals. Joseph K. W. Fung is the Professor Emeritus, Department of Finance and Decision Sciences at Hong Kong Baptist University in Hong Kong. Jaewook Lee is the Professor of Industrial Engineering, Seoul National University. Peter P. Lung is the professor University of Dayton.

Leading journals

Table 1 shows the top 10 journals with the most published articles on derivative markets, which account for 22.14 percent of all articles. The "Journal of Futures Market," with 60 articles, was the journal that published the most articles on derivative markets (7%). It's worth noting that the "Journal of Banking and Finance" is ranked second, with 35 articles (4.1%) and some of the most cited articles are come from the above two journals. The journal of Energy Economics comes next with 14 articles (1.63%). The three journals in the following table, "Energy Economics","Climate Policy" and "Energy Policy" were publishing research articles only related to carbon market, emission trading, climate change and energy market.

Table 1:- Most contributing journals.

SL. No.	Journal	No. of Documents
1	Journal Of Futures Markets	60
2	Journal Of Banking and Finance	35
3	Energy Economics	14
4	American Journal of Agricultural Economics	13
5	International Review of Economics And Finance	13
6	Energy Policy	12
7	Climate Policy	11
8	International Review of Financial Analysis	11
9	Journal Of Financial Economics	11
10	Applied Financial Economics	10

(Source: https://www.scopus.com)

Among other journals in the above table, the "Journal of Financial Economics" comes in the list of top cited article sources.The American Journal of Agricultural Economics published largely research articles on commodities derivatives and production hedging.

Leading Instituitions and Country

While researching the most prolific country and organisation (Table 2), we can conclude that 90 percent of derivative market studies are located in 30 different countries, the United States (257) having the most documents, followed by the United Kingdom (111), and China (83). Sungkyunkwan University, Korea (16) has the most documents published organisation in Derivative Market.

Table 2:- Most contributingCountry and Institution.

SL. No.	Journal	No. of Documents	Organization	No. of Documents
1	USA	257	Sungkyunkwan University, Korea	16
2	UK	111	University of Illinois Urbana-Champaign	15
3	China	83	Korea Advanced Institute of Science and Technology	15
4	Germany	63	The University of Hong Kong	12
5	Australia	52	New York University	12
6	South Korea	52	Leonard N. Stern School of Business	11
7	India	49	University of Technology Sydney	9
8	Taiwan	39	University of Melbourne	8
9	Hong Kong	34	Hong Kong Polytechnic University	7
10	Canada	28	National Chiao Tung University	7

(Source: https://www.scopus.com/)

The other prominent institutions engaging in this research are the University of Illinois, the Korea Advanced Institute of Science and Technology, the University of Hong Kong, and New York University. The above table provides a list of othert most contributing organisations and countries.

Analysis of co-occurrence of keywords

Word co-occurrence refers to the joint occurrence of terms in a given text. To identify the relationships between concepts within a topic, the content is analysed based on the co-occurrence of pairs of terms or words (Choijil et al., 2022). Thus, the greater the frequency of word co-occurrence, the stronger the conceptual linkage. It is possible to establish the central themes developed by the authors, as well as the relationship that exists between these themes, by extracting the keywords, descriptions, or titles of the documents (Linnenluecke et al., 2020). The number and grouping of keywords in the VOS viewer depends on the minimum number of determined occurrences (Choijil et al., 2022).The aim of the co-word analysis is to draw the conceptual structure of a framework using a word co-occurrence net-work to map and cluster terms extracted from keywords, titles, or abstracts in a bibliographic collection (Aria & Cuccurullo, 2017).

The minimum number of times a keyword appears in a publication was initially set to the default value of 5. 185 keywords out of 3720 met the criteria. However, the resulting image is far too cluttered to allow for meaningful analysis. As a result, the minimum number of occurrences of keywords was kept increasing by one.The best results were obtained with a minimum of six occurrences of each keyword. Thus, 144 keywords, 5 clusters, and 2969 links with total link strength of 6006 were finally obtained. The results of the VOS viewer software on the database obtained directly from Scopus are shown in Fig. 3.

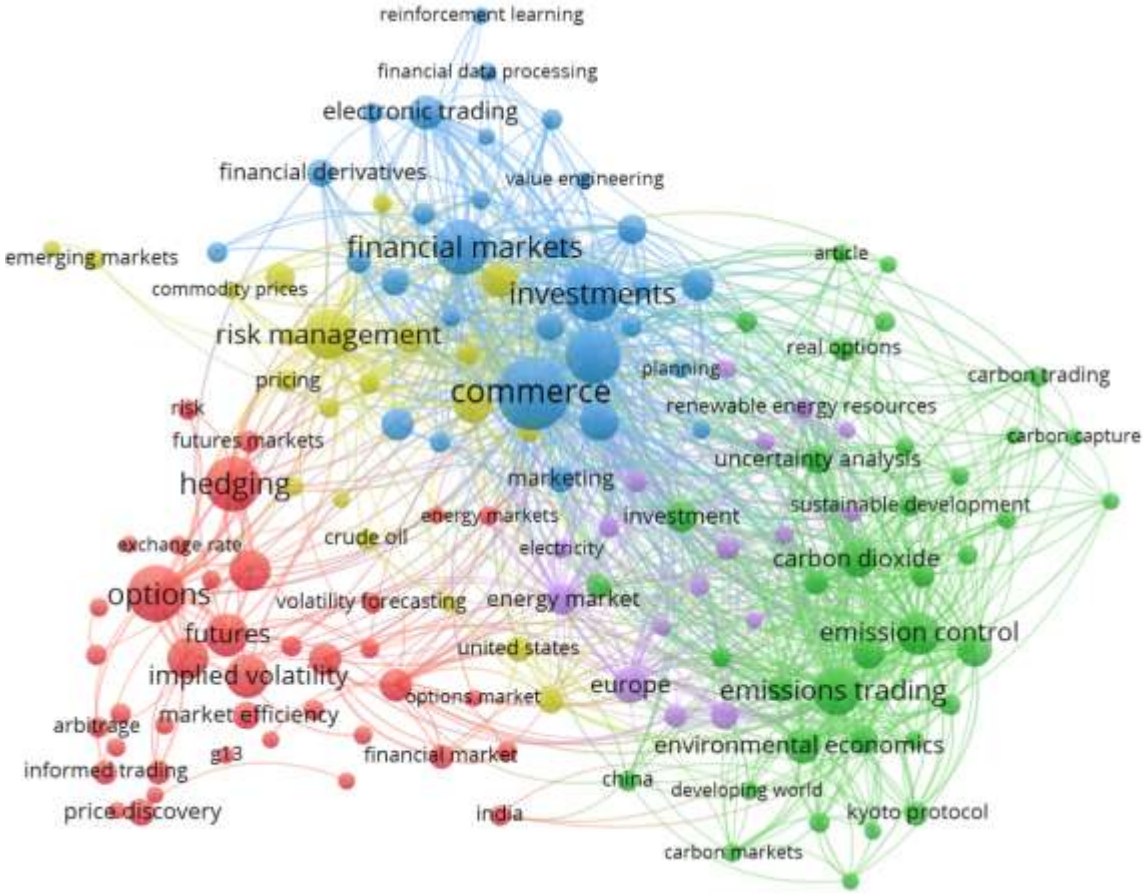

Figure 3:- Network Visualization of Co-occurrence of Keywords.

Each color represents a subset of keywords grouped according to the number of publications in which they occur together (Van Eck & Waltman, 2010). The larger the size of the circle, the greater the number of articles containing that keyword. This analysis allowed us to identify five cluster of studies on derivative market in the last 45 years.

Cluster-1 has been marked with red color and contain 39 items. The most significant keyword of this cluster is "options" with 63 occurrences. In the second place, it is the keyword "hedging" with 59 occurrences. The other significant keywords of this cluster are "futures", "implied volatility", "stock market", "derivatives" and "volatility".One of the important ideas from this cluster is the relationship between asset's price volatility and hedging with futures and options.

Cluster-2, which is green in colour, contains 37 items. This cluster's most important keyword is "emissions trading," which has 46 occurrences, followed by "emission control," which has 35 occurrences. This cluster's other important keywords are "environmental economics," "carbon dioxide," "climate change," and "carbon emission." The majority of the keywords in this cluster are associated with energy and emissions trading.

Cluster-3 is denoted by the blue colour and contains 30 items. With 99 occurrences, the most important keyword in this cluster is "commerce." The keyword "investments" comes in second with 61 occurrences. Other important

keywords in this cluster include "financial market," "costs," "economics," "electronic trading," and "financial derivatives." The majority of the keywords in this cluster are associated trading and investments in financial market.

Cluster-4 is olive yellow and contains 21 items. The most common keyword in this cluster is "risk management," which appears 48 times, followed by "risk assessment," which appears 28 times. This cluster's other important keywords are "stochastic system," "stochastic volatility," "commodity prices," and "financial risk." This cluster is primarily comprised of keywords related to risk management and volatility forecasting.

Cluster-5 is purple in colour and has 17 items. With 25 occurrences, the most important keyword in this cluster is "europe." The keyword "energy market" comes in second with 20 occurrences. Other important keywords in this cluster include "European Union," "natural gas," and "energy efficiency." The majority of the key words in this cluster are related to the European energy market.

Co-citaion analysis of cited authors

Co-citation of two articles occurs when both are cited in a third article. Thus, co-citation is the counterpart of bibliographiccoupling(Aria & Cuccurullo, 2017). Usually, co-citation analysis is performed for mapping older papers(prospective analysis – it is dynamic and is best performed within different time slices), whereas bibliographic coupling isused to map a current research front (retrospective analysis – it does not change over time) (Aria & Cuccurullo, 2017).When a co-citation network is constructedat the level of cited references, the raw reference strings are used as the unit ofanalysis. At the level of cited sources, source titles extracted from the rawreference strings are used as the unit of analysis. At the level of cited authors,author names extracted from the raw reference strings are used as the unit ofanalysis (Van Eck & Waltman, 2022).Because the study already covered bibliographic coupling of documents and journals, co-citation analysis is performed only at the level of the cited reference in this study.

In order to conduct the analysis, the minimum number of citations of an author was set at the default value of 20. Out of 22337 authors311 met the threshold. For each of the 311 authors, the total strength of the co-citation links with other author was calculated by the VOSviewer. To avoid small cluster, the minimum cluster size was set to 10. Finally, 311 authors are grouped in to 4 clusters with 28990 links and206247 total link strength. Figure 4 presents a visualisation of the authors' co-citation network over the course of the study.

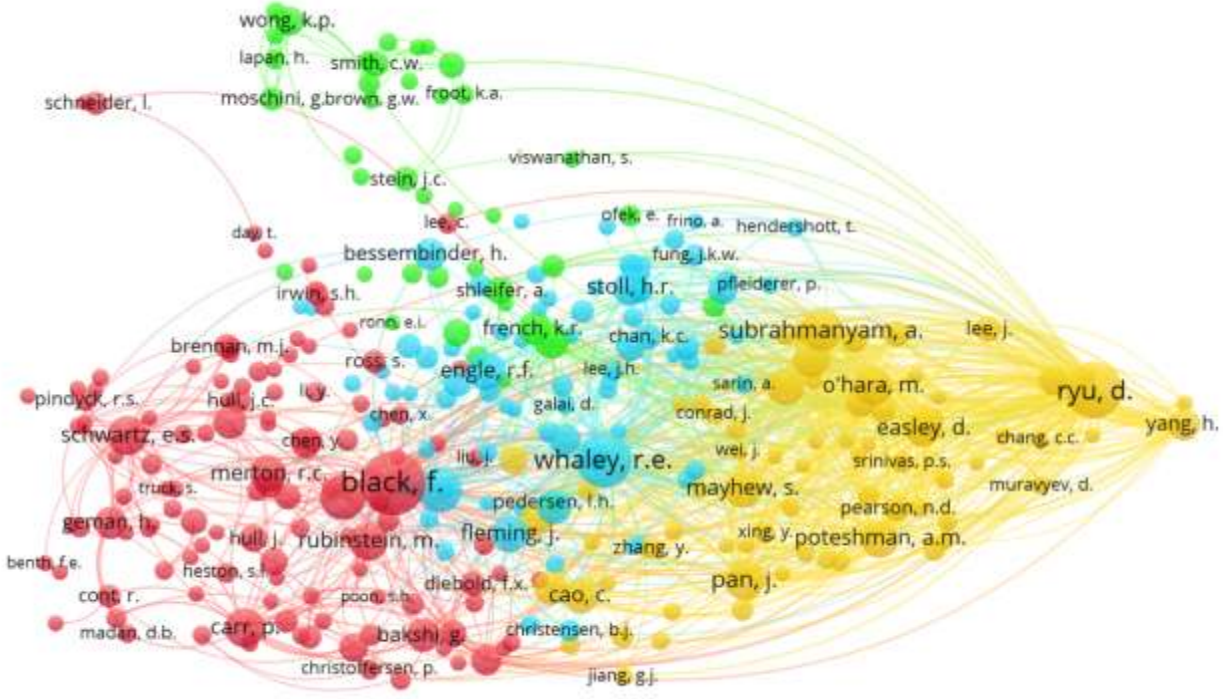

Fig.4:- Co-citation analysis of cited authors.

The cluster-1 highlighted in red color contains 120 authors and blue colored cluster 2 contains 77 authors. 3rd and 4th (yellow and green) clusters are included 73 and 41 authors respectively.The clusterwise summary of top 10 most cited authors are presented in Table-4. According to the data in the Table-4 Fischer Black is the most prominent author in the derivatives market (316 citations, 307 links and 7652 totla link strength). Other notable authors in the field include Myron Scholes, Robert E. Whaley, and Doojin Ryu, all of whom have extensively researched and contributed to the derivative market and have numerous valuable publications to their credit.

Table 3:- Clusterwise Co-Citation Analysis of Most influential authors.

Cluster 1(Red)		**Cluster 2 (Blue)**		**Cluster 3(Yellow)**		**Cluster 4(Green)**	
Cited Author	***No. of Citations***	***Cited Author***	***No. of Citations***	***Cited Author***	***No. of Citations***	***Cited Author***	***No. of Citations***
Fischer Black	316	Robert E. Whaley	235	DoojinRyu	252	Eugene F. Fama	99
Myron Scholes	161	Tim bollerslev	162	AvanidharSubrahmanyam	140	Kenneth R French	86
Peter Carr	123	Robert F. Engle	123	Jun Pan	127	Kit Pong Wong	70
Eduardo Schwartz	123	Jeff Fleming	101	Maureen O. Hara	122	Andrei Shleifer	62
Mark Rubinstein	109	Hans R. Stoll	96	Stewart Mayhew	117	Philippe Jorion	59
Robert C. Merton	105	Stephen Figlewski	93	Kalok Chan	115	Clifford W. Smith Jr.	55
GurdipBakshi	87	HendrikBessembinder	79	Allen M. Poteshman	115	Rene M. Stulz	53
Darrell Duffie	87	YiumanTse	68	Richard Roll	106	Jeremy C. Stein	50
HelyetteGeman	82	Steven Manaster	67	David Easley	105	Matthew Richardson	44
Stephen A. Ross	75	Joel Hasbrouck	66	Charles Q. Cao	98	Sheridan Titman	44

(Source: Author)

The following interpretations are based on the clusterwise analysis.Cluster-1marked in red includes 120 authors and most of them did research in the area of option pricing. The most cited research work of the authors in this cluster includes the famous "Black-Scholes Option Pricing Model". The formula used in the model was developed by economists: Fischer Black, Myron Scholes and Robert Merton (Black & Scholes, 1973). The Black-Schole model is considered as a very elegant piece of research in the area of derivative market. Binomial Option pricing model is another most cited article and was developed more formally by Cox, Ross, and Rubinstein (Ross et al., 1979).The remaining most influential authors in to ten list of cluster-I are: Peter Carr (Carr, 2000), GurdipBakshi (Bakshi et al., 2012), Darrell Duffie (Duffie et al., 2000),and HelyetteGeman (Gemen & Yor, 1996).The second blue-colored cluster contains 77 cited authors, with the majority of research relating to market information, volatility measurement, and trading volume.Robert E. Whaley (Stoll & Whaley, 2016)is the most influential author in this group with 235 citations. Other most cited authors are Tim Bollerslev with 162 citations, Robert F. Engle (Engle, 1982) (123 citations), both of them are co-authors of the chapter Arch Models(Bollerslev et al., 1994)in Hand book of Econometrics. Cluster-3 contains 73 authors and most of the studies are relating to trading volume in options relative to volume in underlying stock.DoojinRyu(Ryu, 2011) is the most cited author in this cluster with 252 citations, 192 links and 14632 total link strength followed by AvanidharSubrahmanyam with 140citations.The final cluster has only 41 authors, and Eugene F. Fama is the most cited author with 99 citations, 274 links, and 3185 total link strength. Kit Pong Wong(Wong, 2003),Andrei Shleifer(Shleifer & Vishny, 2005),Philippe Jorion (Jorion, 1995), and others are also influential authors in this cluster.

Discussions:-

While some of the seminal papers on the derivative market were published in the 1970s (e.g., Black & Scholes,(1973), Chiras & Manaster (1978), Ross et al., (1979)) the pace of research in this area did not pick up until

1997. This relies heavily on the work of Myron Scholes and Robert C. Merton, who were co-winners of the 1997 Nobel Memorial Prize in Economic Sciences for their research on derivate valuation. We can also see that this field of research has expanded quickly, especially since 2004. An analysis of leading authors shows that the author DoojinRyu has the highest number of publications with 13 documents. The "Journal of Futures Market," with 60 articles, was the journal that published the most articles on derivative markets. The United States is the most contributing country with 257 documents published in this area and with 16 publications The Sungkyunkwan University, Korea has the most documents published organization in Derivative Market.

Five groupings were found when keyword co-occurrence was examined. The first cluster contains keywords for futures and options hedging and asset price volatility. The issues of energy derivatives and emissions trading are predominantly mentioned in the second group of keywords. The third cluster has keywords related to financial market trading and investing, while the fourth cluster has phrases related to volatility predictions and risk management. The last and most important keyword group has to do with the European energy market.

Based on co-citation analysis the authors are grouped in to four clusters with 28990 links and 206247 total link strength. According to Co-citation analysis, Fischer Black is the most influential author in the derivatives market with 316 citations, 307 links and 7652 total link strength and other notable authors in the field include Myron Scholes, Robert E. Whaley, Eugene F. Famaand DoojinRyu. The overall analysis reveals that majority researches in derivative market are associated to the topic "information flow and price discovery of underlying assets".The United States, United Kingdom, China, Germany, and South Korea are the most collaborative countries in derivative market research.

Conclusion and future scope of research work:-

This study conducted a bibliometric analysis of derivative market literature based on Scopus database. The tools such as performance analysis, co-occurance analysisand co-citation analysis were used to examine various elements such as publishing and citation patterns, keywords, author partnerships, and country collaborations. This study analyses the most prolific authors, author-associated institutions, affiliated countries, and most productive journals, as well as the pattern and significant subjects of derivative market research. As a result, this article adds a significant piece of work to an existing body of knowledge pertaining to the derivative market

The results indicates that in the field of derivative market research has happened in five themes as identified through co-occurrence of keyword analysis.The publications reviewed here have assisted in identifying the key research gaps and highlighted future study directions, particularly with relation to empirical research on options trading strategies, the area where research is very rare.Future lines of research could also incorporate, for example,the research to analyse the informational content of options trading volume in the Indian stock market or the effectiveness of volatility-based trading strategies in options. Another area for further research may be the study to examine the effect of covid-19 pandemic on derivative trading activity on exchanges in India.

This current study has some drawbacks. The derivative market encompasses a wide range of products such as equity derivatives, commodity derivatives, foreign exchange derivatives, interest rate derivatives, swaps, and so on; however, an in-depth investigation of these products is beyond the scope of this study. This study looks at the derivative market as a whole, and there is a need for bibliometric research in specialised areas of the derivative market, such as commodity derivatives, in the future. Another limitation is that this study is conducted based on information extracted from Scopus database only. Other databases like Web of Science, Dimensions, Google Scholar, etc., could also be used for extraction of data in future studies. The keyword search could be modified to include additional keywords so that more publications relevant to this field are included in the study. The Science mapping should be reinforced with abstract reading and manual selection of articles, followed by extensive reading of the entire text, for an in-depth understanding of the subject domain. In the future, researchers may conduct a systematic literature review and a meta-analysis of the field.

Author Contribution statement

The authors confirm their contribution to the paper as follows:

Study conception and design: Subeesh V. K. and M. A. Joseph; data collection: Subeesh V.K.; analysis and interpretation of results: Subeesh V. K. draft manuscript preparation: Subeesh V,K, and M. A. Joseph. All authors reviewed the results and approved the final version of the manuscript.

Conflict-of-interest statement

The authors have no conflicts of interest to declare. All authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication

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