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Big Data in Finance: A Systematic Literature Review

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Abstract. Big data is not a new term in finance; hence many research studies have explored different dimensions of big data in finance. In view of plethora of such studies, no single study sum-up the entire “Big Data in finance” universe. Therefore, the present study is an attempt to bring the gist of all those studies to understand the microstructure of big data in finance. The study does a systematic review of existing literature on the topic. Year-wise, Author-wise, Citation-wise, Affiliation-wise, Keywords-wise and Source-wise listing of literature are the parameter to conduct present study. Bibliometric method on Scopus database is employed. This study provides insights on trends and future scope of big data in finance. As a result, sub-sets of big data in finance are identified namely artificial intelligence, credit-rating, financial reporting financial crisis, stock trading, assets-pricing, portfolio optimization, banking & insurance and auditing. All these sub-set are insighted with influence of big data. The study also suggests that field like cryptocurrency, green finance, sustainability, financial accessibility is the future of big data in finance.

1. INTRODUCTION

Big data denotes the excess amount of information. Stock market generates tick by tick data or high frequency data, can be one such example of. Each and every move of an individual or organization can be counted as some data point that can be used for further analysis. As per International Data Corporation, the world generates more data every two days than all of humanity generated from the dawn of time to the year 2003. Such big data movement has revolutionized and reshaped the financial market operations. Every financial transaction especially after advent of internet uses is easy to track. Therefore, recoding of each moves brings us the uncountable data for analysis. Such data usage in finance has always been major research topic for discussion. Though not all influential studies on the topic are found to be part of one single study to present “Big Picture” of big data in finance. Therefore, the present study is conducted to fill the gap of such study by framing following research objectives:

1.1 Objectives

Based on available number of studies, it has been observed that impact of big data in finance has admitted it's significant presence in research though many questions still remain unanswered and has emerged for further exploration. The classical definition of big data with three V's i.e., volume, velocity, and variety has a strong relation to financial market moment and artificial intelligence, that needed to reflect the opportunities and challenges that big data poses to research and practice in finance. Such emerging topics frames following research objectives for the present paper as:

- RO1. To identify the publication trend for Big data in finance
- RO2. To find most influential articles and top contributing journals on Big Data in finance
- RO3. To identify top contributing authors and institutions on Big Data in finance
- RO4. To draw inferences about future scope of studies on Big Data in finance

The remaining paper is explained in three sections on *Methodology, Findings & Conclusions* consecutively.

2. LITERATURE REVIEW

For modern industry, data generated by machines and devices, cloud-based solutions, business management, etc., has reached a total volume of more than 1000 Exabytes annually and is expected to increase 20-fold in the next ten years. McKinsey & Company reports that “manufacturing stores more data than any other sector close to 2 Exabyte of new data stored in 2010”. Avaniidhar (2019)’s study does literature and present comprehensive view on the topic. Nobanee (2021) conducts a bibliometric review on big data in finance and discuss present and future scope of studies. Cockcroft and Russell (2018) analyze existing literature on Big Data in Finance to examine research scope on the topic. None of these studies has undertaken a comprehensive of all extant literature on big data in finance. Hence, the present study conducts a comprehensive literature review on big data in finance which methodology is explained separately in Methodology section of this study. Here, challenge was to find all such related studies on topic related to big data in finance. We study different strand of literature to complement our review process for the paper.

3. METHOD

The present study conducts a bibliometric search of literature available on “big data” in finance. Scopus database is used for conducting the search. This bibliometric search employs the Scientific process method named SPAR-4-SLR for Systematic Literature Reviews by following three steps procedure i.e., *assembling*, *arranging*, and *assessing* from Paul et al. (2021) study. Each of these three steps further contains sub-steps as depicted in Figure 1, is explained as:

Assembling	<p>Search title: Big Data in Finance Source: Scopus Document: 2093 Keywords filter within search: <i>Big data, Finance, Risk assessment, Forecasting, Investment, Financial management, Financial data, Financial risk, Financial accounting, Financial innovation, FinTech, Financial sector, Financial services, Financial institutions, Financial development, Financial system, Financial data processing, Supply chain finance, stock return and taxation</i> Document: 1521 Subject Filter: Business & Management, Economics, Econometric & Finance Document: 215</p>
Arranging	<p>215 documents are further arranged as Year-wise, Author-wise, Source-wise, Citation-wise, Affiliation-wise, and keywords-wise</p>
Assessing	<p>Analysis Method: Bibliometric analysis method (publication trends, source titles, authors, affiliation, etc.) Agenda proposal method: reading articles to discuss best practice and future scope Reporting convention: Tables, Figures Limitation: Studies from other databases are not included Source of support: No support or funding</p>

Figure 1 SPAR-4-SLR

3.1 Assembling

The study initiates the bibliometric search by using the phrase “big data in finance” in search box of Scopus database. This search result generates 2093 documents in response. To this 2093 document, study limits the search by using keywords (Figure 1). With keywords filters, the search results in 1521 documents.

This paper aims to focus basically on management and Economics area only. Hence, to this 1521 documents subject area filter is also applied by limiting studies to two subjects' area only i.e., to Business, Management & Accounts and to Economics, Econometrics & Finance. This subject area filter limits number of studies to be 215 documents. These 215 documents further processed for arranging and assessing.

3.2 Arranging

These 215 documents are further arranged as Year-wise, Author-wise, Source-wise, Citation-wise, Affiliation-wise and keywords-wise. This arranged data is depicts in Table 1 to Table 5 and in figure 1 & Figure 2. This arranged list of documents is further used for assessment.

3.3 Assessing

For this study, we read and assess those studies which are cited more than 100, or/and of author's who has written minimum two articles, or/and from source title have more than 2 publications or form the countries with minimum 10 article publications. This criteria for assessment is used for this study given limited scope of writing. This restriction limits the document to be 59. We read each of these studies, and discussion and inferences has been drawn of that basis.

4. DATA COLLECTION

Data collection for the present study includes secondary sources i.e. available literature on "big data in finance". As mentioned in methodology, number of keywords are searched and filtered with different criteria. That left us with 215 documents. These 215 documents were read, arranged with different filter, and summarized for achieving the mentioned research objectives of the present paper.

5. RESULTS AND DISCUSSION

Finding of the study is discussed for each of the five research objectives. We have started to summarize findings with quantifying the research trends on existing literature.

5.1 ROI. To quantify the trends of publication for Big data in finance

Table 1 and Figure 2 summarizes the trends on publication for big data in finance. The publication year ranges from 1992-2022 i.e., 30 years. Average publication per year is found 10 publications. Highest publication on big data in finance is the year 2021 with 40 publications following by the year 2022 with 25 publications. Though year 2022 is still in progress, there is possibility that 2022 years publication can be the highest publication recording year for big data in fiancé. The lowest number of publications i.e., 0 publication is found for year 1993-96, 1999-2002, 2004, 2008 and 2010.

Table 1: Publication Trends of Big Data in Finance (Descriptive Statistics)

Statistics	Value
Mean	10
Median	5

Continued.

Statistics	Value
Standard Deviation	11.54
Range	39
Minimum	1
Maximum	40
Sum	215

Figure 2 shows the publication trends on Big Data in Finance year-wise. Out of these 215 publications, 203 are published from 2011-2022 that accounts for more than 90% total publication. This trend exhibits the popularity of how much popularity Big Data in Finance has gained in last decade.

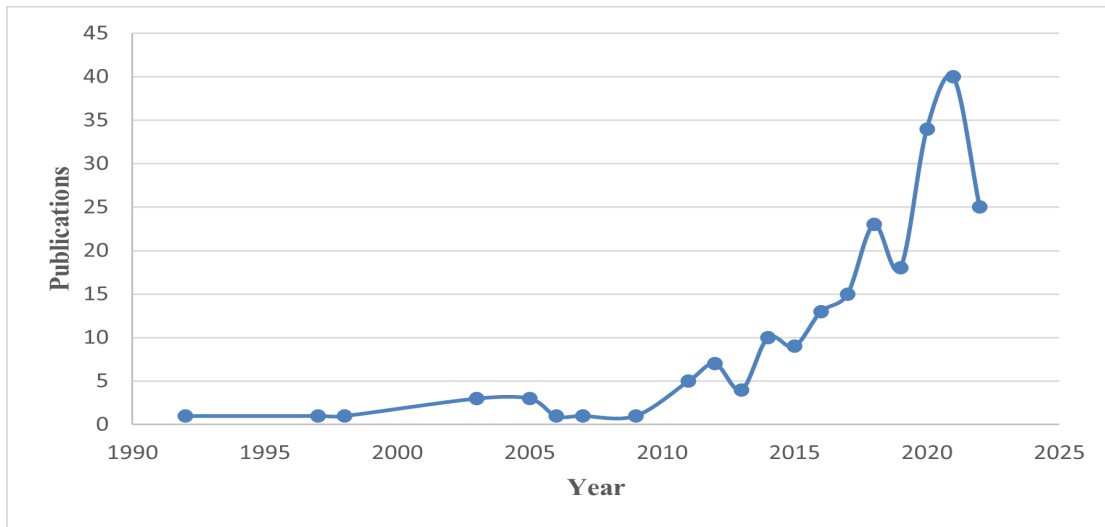


Figure 2 Trend of publication on Big Data in Finance

5.2 RO2. To find most influential articles and top contributing journals on Big Data in finance

Most cited articles are considered to be the most influential study of the subject area. Considering number of citations, Table 2 highlights all publications which has more than 100 citations. Nine such articles are found. Total publication citation is 4450 for all 215 documents. TC/TPC is ratio of Total Citation of single article to total publication citations. TCY is total citation per year. With 851 as total citation, 42.55 total citation per year and 0.19 as ratio of total citation of article and total publication citation (which is 4450), the study by Vickery et al. (2003) tops the table.

Table 2 Influential Articles on Big Data in Finance

Authors	Title	Year	Source title	TC	TCY	TC/TPC
Vickery S.K., Jayaram J., Droge C., Calantone R.	The effects of an integrative supply chain strategy on customer service and financial performance: An analysis of direct versus indirect relationships	2003	Journal of Operations Management	851	42.55	0.19

Continued.

Authors	Title	Year	Source title	TC	TCY	TC/TPC
Nicholson N., Soane E., Fenton-O'Creevy M., Willman P.	Personality and domain-specific risk taking	2005	Journal of Risk Research	519	28.83	0.12
Lee E., Lee B.	Herding behavior in online P2P lending: An empirical investigation	2012	Electronic Commerce Research and Applications	221	20.09	0.05
Bhide A.	Bootstrap finance: the art of start-ups.	1992	Harvard business review	212	6.84	0.05
Heaton J.B., Polson N.G., Witte J.H.	Deep learning for finance: deep portfolios	2017	Applied Stochastic Models in Business and Industry	180	30.00	0.04
Duro J.A., Padilla E.	International inequalities in per capita CO2 emissions: A decomposition methodology by Kaya factors	2006	Energy Economics	167	9.82	0.04
Ma X., Sha J., Wang D., Yu Y., Yang Q., Niu X.	Study on a prediction of P2P network loan default based on the machine learning LightGBM and XGboost algorithms according to different high dimensional data cleaning	2018	Electronic Commerce Research and Applications	147	29.40	0.03
Bhimani A., Willcocks L.	Digitisation, Big Data and the transformation of accounting information	2014	Accounting and Business Research	145	16.11	0.03
Tsai C.-L.	How do U.S. stock returns respond differently to oil price shocks pre-crisis, within the financial crisis, and post-crisis?	2015	Energy Economics	102	12.75	0.02

Further to finding the most influential articles, the present study also collected data on the title sources which has published minimum three article on the topic. Such 7 source titles are identified in Table 3. Industrial Management and Data Systems has published highest number of articles i.e., 5 total publications although Electronic Commerce Research and Application has highest total citation and citation per publication followed by Energy Economics.

Table 3 Highest Contributing Journals on Big Data in Finance

Source	TP	TC	TC/TP	IMF
Industrial Management and Data Systems	5	40	8	4.224
Journal of Enterprise Information Management	4	44	11	5.661
Lecture Notes in Business Information Processing	4	4	1	NA
Technological Forecasting and Social Change	4	25	6	10.884
Electronic Commerce Research and Applications	3	389	130	5.622
Energy Economics	3	326	109	9.252
International Journal of Production Economics	3	70	23	11.251

TP=Total Publication TC=Total citation IMF=Impact factor

5.3 RO3. To identify top contributing authors and their affiliations and top contributing countries on Big Data in finance

Table 4 present data on top contributing authors and their affiliation on the topic. Hassan, M. K. and Sun, E.W. has maximum three articles whereas Crosetto, P. & Regner, T. [11, 12] has highest total citation i.e., 61 citation and highest total citation per publication i.e. 30.5.

Table 4 top contributing authors and their affiliations on Big Data in Finance

Authors	Affiliation	TP	TC	TC/TP
Hassan, M. K.	University of New Orleans, New Orleans, United States	3	22	7.33
Sun, E.W.	KEDGE Business School, Talence, France	3	59	19.67
Al Janabi, Mazin A.M.	Tecnologico de Monterrey, Monterrey, Mexico	2	6	3
Babajide, Abiola Ayopo	Covenant University, Ota, Nigeria	2	6	3
Chen, Yiting	Montpellier Recherche en Management (MRM), Montpellier, France	2	48	24
Crosetto, Paolo	CNRS Centre National de la Recherche Scientifique, Paris, France	2	61	30.5
Im, Hyojin	Korea Credit Guarantee Fund, Seoul, South Korea	2	0	0
Kalema, B. M.	Tshwane University of Technology, Pretoria, South Africa	2	22	11
Regner, Tobias	Friedrich-Schiller-Universität Jena, Jena, Germany	2	61	30.5
Yoon, Taeho	Korea Credit Guarantee Fund, Seoul, South Korea	2	0	0

Table 5 lists the top contributing affiliation on Big Data in Finance. Chinese Academy of Sciences is found to have highest 5 publication although given total citation, Harbin Institute of Technology tops the charts with three publications followed by Indian Institute of Technology Delhi.

Table 5 Top contributing affiliation on Big Data in Finance

Affiliation	TP	TCP	TC	TC/TP	TC/TCP
Chinese Academy of Sciences	5	5	52	10.4	10.4
Renmin University of China	4	3	30	7.5	10
Beijing Jiaotong University	4	2	4	1	2
Università degli Studi di Torino	3	3	16	5.33	5.33
National Chiao Tung University	3	3	59	19.67	19.67
Harbin Institute of Technology	3	3	168	56	56
University of New Orleans	3	2	22	7.33	11
University of Chinese Academy of Sciences	3	3	30	10	10
Indian Institute of Technology Delhi	3	3	101	33.67	33.67
China University of Mining and Technology	3	3	29	9.67	9.67
KEDGE Business School	3	3	59	19.67	19.67

TCP=Total cited publication

Table 6 list countries-wise contribution to the topic of Big Data in Finance. This table list the countries which have minimum 10 publication. China has found to have maximum 73 publications and maximum total cited publication

whereas United Kingdom has highest total citation to total publication ratio and total citation to total cited publications.

Table 6 Top contributing Countries on Big Data in Finance

Country	TP	TCP	TC	TC/TP	TC/TCP
China	73	44	695	9.52	15.80
United States	54	41	1865	34.54	45.49
United Kingdom	21	17	1248	59.43	73.41
India	18	11	156	8.67	14.18
France	13	12	73	5.62	6.08
Germany	11	10	164	14.91	16.40
Australia	10	9	332	33.20	36.89
Italy	10	7	59	5.90	8.43

5.4 RO4. To draw inferences about future scope of studies on Big Data in finance

We perform keyword occurrence as per the use in frequency and year. Figure 3 shows keyword occurrence on Big Data in Finance. Blue represents keyword Finance, Green represents keyword Big Data, Yellow represents keyword Artificial intelligence, and Red represents keyword Investment.

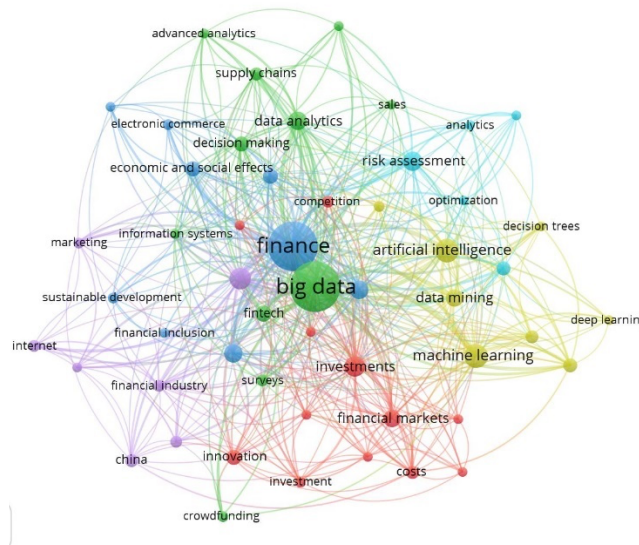


Figure 3 Keyword Co-occurrence Network Analysis on Big Data in Finance

Figure 4 shows year-wise keyword occurrence. Year 2016- 2020 analysis shows transition from keyword Finance to Big Data, Machine Learning, Artificial Intelligence and Data Mining. Keywords like Deep Learning, Decision Tree, Optimization, Decision Support System etc. are used with consistency in all years. So, these keywords can be used to represent overall picture of AI tools in financial Forecasting.

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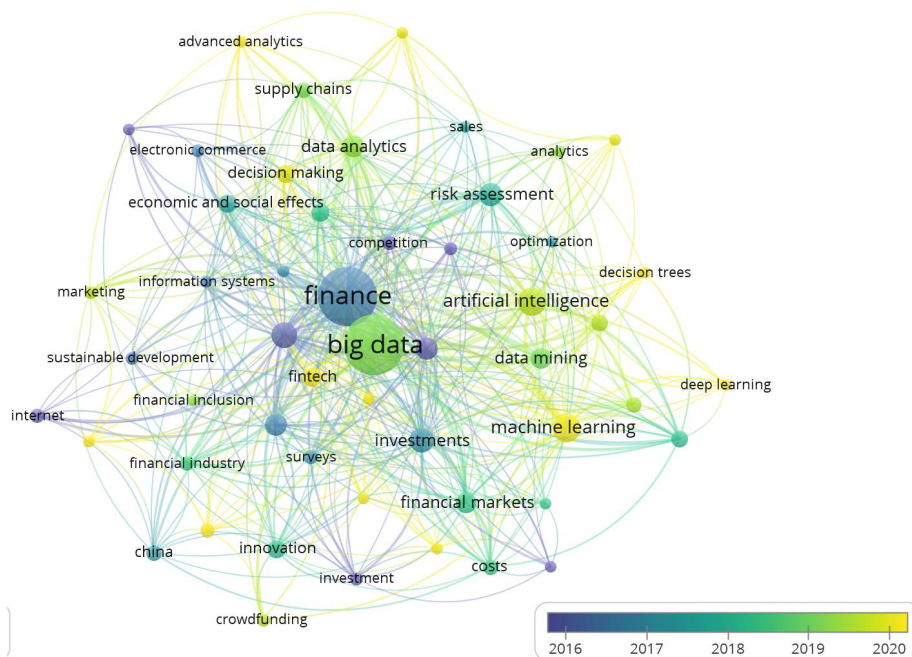


Figure 4 Year-wise Keyword Network Analysis on Big Data in Finance

Apart from network analysis of keyword-occurrence, the detailed reading and extensive reviewing of 215 research articles enables us to comment on future scope of Big Data in Finance. Though the present study uses all for reviewing literature, new terms or/and sub-topics are there to explore. Following research discussion, the study finds following booming area to be studied in Big data in Finance:

- Big Data & Machine learning: Future of Finance
- Application of big data in green finance & sustainability practices
- Big data & universe of cryptocurrency
- Big data in entrepreneurial finance
- Big data role in credit reporting
- Financial accessibility

6. LIMITATION AND SCOPE OF THE STUDY

Though present studies reviews 215 articles for presenting a comprehensive view on Big Data in Finance, there are few limitations that exists with the study. We search only one research engine for finding literature i.e., Scopus that may limit the view of present paper. The keyword used for searching the articles of the topic may also include other non-related keywords as there may be studies on Big Data in Finance with different domain.

These limitations can be overcome by using more keyword and exploring other research databases for finding the articles on the topic. We also strongly suggest doing comprehensive review of employed research methodology and sub-themes which has used integrated view on Big data in finance.

7. CONCLUSION

Findings of this paper concludes that Big data in finance is going to be major area for exploration in future as well. New domains like green practices, sustainability and cryptocurrency opens new doors for such exploratory studies. Automation of day to day working and remote working environment brings competitive edge for use of big data. Big data not only proves to be instrumental in decision making for individual or institutions but also part of policy making that affects economy and world as a whole. Based on reviewing of 59 studies, it can be concluded that big data in finance is not limited to core finance only but has substantially expanded to other domains related to finance e.g. supply chain finance, ESG investment etc. Hence including big data in decision making process is inevitable.

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