# Scientometric Portrait of Dr. Raghuram Rajan: An Economist and 23<sup>rd</sup> RBI Governor

Mukesh Behera<sup>1</sup>, Debraj Meher<sup>2,\*</sup>

<sup>1</sup>Central Library, Indian Institute of Technology, Delhi, INDIA. <sup>2</sup>Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha, INDIA.

#### ABSTRACT

The purpose of the current research is to summarize the many characteristics of Dr. Raghuram Rajan's research output as one of the outstanding Indian economists. The study is based on publication data from the years 1991 to 2022 those were indexed in the Scopus database. Bradford's law, the degree of partnerships, authorship patterns, bibliographic coupling, citation analysis, co-authorship authors, and top sources, publishers, and keywords are all aspects covered in this study. In addition to using research topic network parameters, the authors also consider using an open source, one-of-a-kind tool for logical bibliometrics visualisation analysis that was created using the R language, RStudio, and VOSviewer. Dr. Rajan has produced 100 publications in total, with a 4.5 annual growth rate. Out of a total 38 journals and 23 publishers, he has published his papers most frequently in the Finance and Development journals (15 documents). Dr. Rajan's average number of citations per document is 265.8 and his Degree of Collaboration (DC) with other researchers is 0.61. The United States is the primary partner, and Dr. Rajan's study on economic growth appears most frequently in this cooperation.

# Correspondence:

**Dr. Debraj Meher** Librarian, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar-751003, Odisha, INDIA. Email: meherdebraj@gmail.com

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# **INTRODUCTION**

Raghuram Govind Rajan, better known by his stage name Raghuram Rajan, was born in Bhopal on February 3, 1963. He had his schooling from Delhi Public School. He completed his Bachelor's Degree in Electrical Engineering at the Indian Institute of Technology (IIT), Delhi, earned a Master of Business Administration at the Indian Institute of Management (IIM), Ahmadabad and had his Doctoral Program in Management at the MIT Sloan School of Management ("Didn't Own a Blazer in School, Raghuram Rajan Tells Students," 2014).

Indian economist and scholar Raghuram Rajan was the RBI's (Reserve Bank of India) 23<sup>rd</sup> governor from September 2013 to September 2016. He was worked by the International Monetary Fund (IMF) as its Chief Economist from 2003 until 2006. The Fischer Black Prize was given to him in 2003 for his contributions to the theory and practise of finance. He has also taught finance at the University of Chicago Booth School of Commerce. Rajan is well known for his work in the fields of corporate finance, banking, and economic growth. He has authored several books, including "Fault Lines: How Hidden Fractures Still Threaten the



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World Economy," which warned about the global financial crisis before it happened.

During his tenure as RBI Governor, Rajan introduced several reforms, including the creation of a monetary policy committee and the introduction of inflation targeting. Additionally, he put into place measures to deal with the problem of Non-Performing Assets (NPAs) in the banking sector and unveiled a new framework for handling troubled loans. Rajan's tenure as RBI Governor was marked by controversy, particularly in relation to his comments on the government's policies and his efforts to clean up the banking system. Despite this, he is widely respected for his expertise and his efforts to strengthen the Indian economy. (About Raghuram Rajan, n.d.).

# Top Honours and Awards Related Works

Previously there have been some researches on this kind of topics. In the literature Kalyane and Munnolli (1995) determined the research productivity and collaboration pattern of T.S. West by examining his publications, authorships, and productivity as an individual author. It reveals that, of the 410 papers published between 1951 and 1992, the Quinquennial Collaboration Coefficient ranged from 057 to 1.00, was 0.45 and was the leading subject area. Studies by Kademani *et al.* (1996) identified S. Chandrasekhar's years of expertise, patterns of collaboration, modes of communication, keywords, and other characteristics

of scientific publications. Additionally, they noted that between 1983 and 1987, the highest Collaboration Coefficient was 0.5, the coefficient was 0.46, the number of publications was 7.37, and the number of publications was 4.34. In another study, the predominant focus emphases of librarian and information scientist Bimal Kanti Sen are highlighted by Dutt (2019). Out of his total 390 publication during 1964 to 2018, 184 are research articles and highest document types, the year-wise distribution of authorship pattern, collaborative authors and degree of collaboration, author productivity, core journals and highly cited publications are identified in this paper. Yashodhamma in 2022 in his research paper highlighted Dr. Madras G's 569 total publications and research contributions when he was a scientist at IISc, Bangalore. The investigation showed that 540 documents out of the total publications were under the category of articles, the top-cited journals originated in the US, the degree of collaboration was 1.00, and the Collaboration Co-efficient (CC) was 0.71 (Noruzi et al., 2022). This research examined the research performance of Italian researcher Mauro Guerrini from 2007 to 2021. Mauro Guerrini's research publications are compiled from Web of Science-indexed papers and then examined using the VOSviewer and Bibliometrix R-Package softwares. This study aims to present his scientific image in light of international bibliometric and scientometric indicators Figure 1.

## **Objectives of the Study**

The current study on Raghuram Rajan's research productivity is endeavoured with objectives to:

Examine Dr Raghuram Rajan's research outputs by year.

Identify the top preferred journals and publishers.

Identify the most prolific author and authorship pattern in Dr. Raghuram Rajan's literature.

Identify the Degree of Collaboration of Dr Rajan's Publications.

Know the most cited papers of the Dr Raghuram Rajan.

Examine the national and international collaborations of research publications.

Analyze the top keywords and the networked citations, co-authorship networks based on authors, and bibliographic coupling with documents.

# METHODOLOGY

The study is solely focused on Dr. Raghuram Rajan's Scientometric Portrait as the former Governor of the Reserve Bank of India. Numerous well-known approaches have been added into this study based on the available literature. The information was gathered from the "Scopus Database," a multidisciplinary citation and abstract database that includes an author key search and the string "AU-ID ("Rajan, Raghuram G. 7101892426")." Throughout the study period, a total of 100 papers are downloaded, used RStudio for bibliometric analysis, VOSviewer for visualisations and Canva for presentation. For further analyse data certain objective requirements have been considered.

#### **Scope and Limitations of the Study**

The research outputs of Dr. Raghuram Rajan, as recorded in the SCOPUS database as of 11.10.2022 are included in the scope of this study and are limited to this database only. Publications that are not indexed in the SCOPUS database are excluded.

# RESULTS

#### **Analysis of Scientific Production**

Figure 2 shows Dr Raghuram Rajan's publications by year. He published a total of 100 documents from 1991 to 2022, a lengthy 32 publication years, with an annual growth rate of 4.57 percent and 26576 total citations. It has been determined that his first publication was made in 1991. The yearly distribution of publications, citations, and their percentages are detailed in Figure 2. There were largest number of publications in the year 2006 (14 publications with 1781 citations), followed by the years 2011 (09 with 1375) and 2005 (08 with 1100), and the lowest

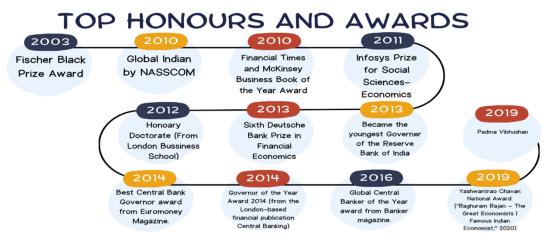


Figure 1: Top honours and awards (generated on "Canva").

number was in the year 2019 (01 with nil). Additionally, it was noted that within this time span, the year 1995 (4683 citations) gathered highest and in the years 2018 and 2019 it was lowest citation evaluations (Nil citation) respectively.

#### **Document Type-Wise Publications**

Dr. Rajan has written numerous scientific publications throughout his professional and research career, contributing to a variety of scientific fields. Table 1 summarizes the types of documents that Dr. Rajan has contributed, including articles, conference papers, notes, reviews, books, and editorials. Out of 100 publications, it is noted that article is the most favoured category 71 (citation 24631), followed by conference paper 08 (664), note 08 (20), review 08 (307), and editorial 2 (22) is the least preferred ones.

#### **Top Global Cited Documents**

Every research must be evaluated according to its impact, and one essential and widely used metric for determining influence is counting the number of citations. Citations are evidence that the published work of the author(s) and the journal have been recognised positively, and it may be claimed that the recognition or influence of the published work is directly correlated with the number of citations received. The top ten publications by the number of citations, as shown in Table 2, are the most cited ones. The most cited work among Dr. Rajan's 100 publications, "Financial Dependence and Growth," with 3374 total citations and receives 134.96 citations annually, and "What Do We Know about Capital Structure?" receives (2840 and 101.43). The third-highest cited paper is titled "Some Evidence from International Data," and the fourth-highest cited paper is titled "The Benefits of Lending Relationships: Evidence from Small Business Data" (2174, 74.97).

## **Citation with Documents**

Figure 3 shows that Dr. Rajan's "rajanr.g. (1998a)" has received 3321 citations, followed by papers by "Petersenm, A. (1994),"

which received 2150 citations, "Berger, A.N. (2005)," which received 774 citations, and so on. The overall strength of the citation linkages will be determined for each of the 72 documents. There is a selection of the documents with the most links.

#### **Analysis of Sources**

Table 3 examines the primary communications networks Dr. Rajan used for disseminating his research findings. The articles of Dr. Rajan have been published in a total of 38 journals, according to the database. The citations, impact factor, *h*-index, *g*-index, *m*-index, and year of initial publication of the journals have all been enumerated. According to the analysis of the table, Dr. Rajan preferred to publish his research papers primarily in the journals namely: Finance and Development (13), American Economic Review and Journal of Finance (11), Journal of Financial Economics (9), Quarterly Journal of Economics (6), The Journal of Finance (4), Review of Financial Studies (4), Foreign Affairs and Journal of Political Economy (3), and Cato Journal (2). but, the least publication and citation at Review of World Economics, Imf Economic Review and O1 citation).

#### **Bradfords Law Implementations in Core Journal**

A bibliometric law known as Bradford's Law of Scattering was developed by Samuel Clement Bradford and named after him by BC Vickery Bradford. The law of scattering is a method for analysing journal output. Bradford's Law of Scattering, which arranges journals in equal zones and descending order of productivity, reveals the quantitative relationship between journals. A field's journals can be broken down into three sections, each containing roughly one-third of the total number of articles: a core with a few journals, a second zone with additional journals, and a third zone with the majority of journals (Miss, 2017). Figure 4 shows that only publications from the three major journals indicated in Zone 1-Finance and Development (13), American Economic Review (11), and Journal of Finance (11)-are included

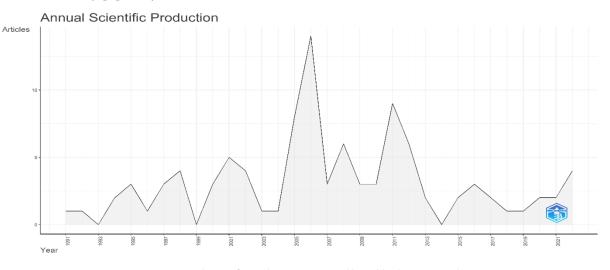


Figure 2: Annual scientific production (generated by "Biblioshiny" in RStudio).

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<b>Doc. Тур</b> е	No. of Doc.	No. of Citations	Percentage of Doc. (%)	Percentage of Citation (%)				
Article	71	24631	71.00	92.68				
Book	3	932	3.00	3.51				
Conference Paper	8	664	8.00	2.50				
Editorial	2	22	2.00	0.08				
Note	8	20	8.00	0.08				
Review	8	307	8.00	1.16				
Total	100	26576	100.00	100.00				

#### Table 1: Document type-wise publications.

#### Table 2: Top ten global cited documents.

Articles Citations	Total Citations	TC per Year	Normalized TC	DOI	Ranked
(Rajan and Zingales, 1998)	3374	134.96	3.12	NA	1
(RAJAN and ZINGALES, 1995)	2840	101.43	1.82	10.1111/j.1540-6261.1995.tb05184.x	2
(PETERSEN and RAJAN, 1994)	2174	74.97	1.74	10.1111/j.1540-6261.1994.tb04418.x	3
(RAJAN, 1992)	1661	53.58	1	10.1111/j.1540-6261.1992.tb04662.x	4
(Rajan and Zingales, 2003)	1583	79.15	1	10.1016/S0304-405X(03)00125-9	5
(Petersen and Rajan, 1995)	1351	48.25	0.87	10.2307/2118445	6
(Petersen and Rajan, 1997)	1041	40.04	2.19	10.1093/rfs/10.3.661	7
(Petersen and Rajan, 2002)	864	41.14	2.46	10.1111/1540-6261.00505	8
(Rajan <i>et al.</i> , 2000)	797	34.65	1.74	10.1111/0022-1082.00200	9
(Berger et al., 2005)	784	43.56	5.7	10.1016/j.jfineco.2004.06.003	10

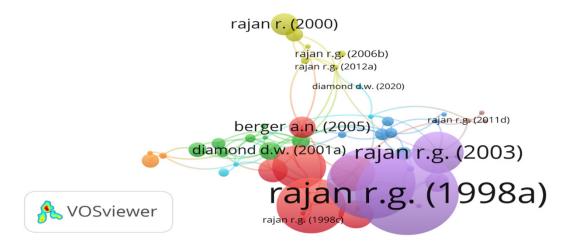


Figure 3: Citation with Documents (generated by VOSviewer).

Table 5. Top Ten Journals.							
Journals Name	NP	тс	IF	h_index	g_index	<i>m</i> _index	PY_start
Finance and Development	13	109	0.72	6	10	0.316	2004
American Economic Review	11	4079	10.54	10	11	0.4	1998
Journal of Finance	11	3498	7.52	9	11	0.346	1997
Journal of Financial Economics	9	3217	7.80	7	9	0.35	2003
Quarterly Journal of Economics	6	3025	16.30	6	6	0.207	1994
The Journal of Finance	4	7167	7.52	4	4	0.129	1992
Review of Financial Studies	4	1248	8.34	3	4	0.115	1997
Foreign Affairs	3	12	2.42	2	3	0.167	2011
Journal of Political Economy	3	742	9.24	2	3	0.091	2001
Cato Journal	2	11	0.62	2	2	0.111	2005

#### Table 3: Top Ten Journals.

## Bradford's Law

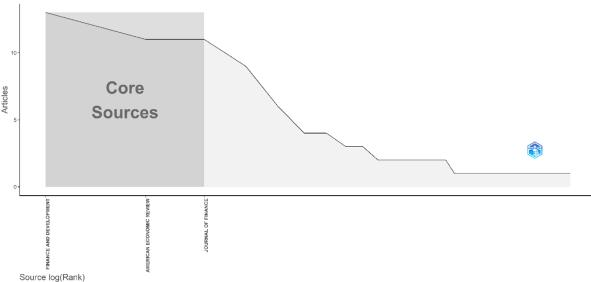


Figure 4: Bradfords law implementations in core journal (generated by "Biblioshiny" in RStudio).

in the analysis. Zone 3 has 27 journals, as compared to Zone 2's 8 journals.

#### **Analysis of Publishers**

The top ten publishers that Dr. Raghuram Rajan chose to publish his works are shown in Figure 5. It has been determined that Dr. Rajan's publications have been published by a total of 23 publishers. As shown in the graph, Dr. Rajan preferred to publish his research papers primarily in Wiley Publisher, where he published 16 of them between 1991 and 2022. Elsevier (15), the American Economic Association (13), the International Monetary Fund (13), Oxford University Press (13), the University of Chicago Press (4), the Council on Foreign Relations (3), Princeton University Press (3), the Cato Institute (2), the Federal Reserve Bank of St. Louis (2), and MIT Press. (2).

#### **Analysis of Authors**

According to research on Dr. Rajan's writings during the last 32-years period between 1991 and 2022, there are 43 authors contributed to the 100 articles' publication in total. The data were organised according to the number of publications each author had, and a ranking list of the top 10 authors was surfaced. The top 10 authors who published works with Dr. Rajan's association are listed in Table 4. This table made it obvious which 14 publications with 2340 citations Diamond D.W. was associated with, including those by Zingales L. (09, 9599), Subramanian A. (06, 1268), Petersen M.A. (05, 6214), Ramcharan R. (06, 113), Prasad E.S. (04, 378), and others.

#### **Co-authorship of Author**

According to Figure 6, the authors who have the strongest overall links will be chosen to be co-authors of the author network. The overall strength of the co-authorship ties with other writers will be determined for each of the seven authors in this network. The links between the nodes, or co-authorships, show the researchers' scientific collaborations (i.e., co-authorships) (Elahi *et al.*, 2021). The size of the nodes indicates the quantity of publications, whilst the thickness of the linkages indicates the quantity of collaborations. Dr. Rajan is the top in the network with 22496 citations, 62 papers, and 32 TLS (total link strength). Followed by Diamond, DW is (2292 with 14 with 14) and Zingales, l. is (485 with 9 with 9) and so on.

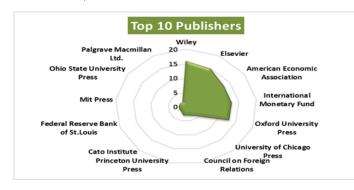


Figure 5: Top ten publishers.

#### **Year-Wise Authorship Pattern**

Table 5 displays Dr. Raghuram Rajan's line-by-line appearances based on authorship patterns. Only one, two, three, four, five, and fifteen author publications are available with this study, not. With 40 publications, two-author papers took first place, followed by one-author papers in second place with 39 publications, and three-author papers with 16. However, according to 2006, one-author publications are more prevalent. The majority of articles have two-authors, followed by three-authors and then four-authors.

#### **Document Wise Authorship Pattern**

Using a document wise authorship pattern, Table 6 highlights Dr. Raghuram Rajan's research publications. Overall document authorship distribution per document type. According to the research, articles have the most single-author publications (24), followed by those with two authors (33), three authors (12), and so on, across all document types. Conference paper, note, and review is the second-highest document category, with (8).

Table 4: Top ten associate author
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Element	No Docs	Citations	h_index	g_index	<i>m</i> _index	Starting Year
Rajan R.G.	100	26576	48	100	1.5	1991
Diamond D.W.	14	2340	10	14	0.435	2000
Zingales L.	9	9599	9	9	0.321	1995
Subramanian A.	6	1268	6	6	0.353	2006
Petersen M.A.	5	6214	5	5	0.172	1994
Ramcharan R.	6	113	5	6	0.417	2011
Prasad E.S.	4	378	4	4	0.235	2006
Kashyap A.K.	4	676	3	4	0.143	2002
Stein J.C.	3	1447	3	3	0.143	2002
Acharya V.V.	2	161	2	2	0.167	2011

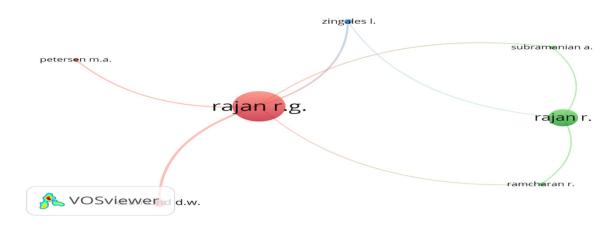


Figure 6: Co-authorship of author (generated by VOSviewer).

#### Table 5: Year-wise authorship pattern.

Year	One Author	Two Author	Three Author	Four Author	Five Author	Fifteen Author	Total
1991-1995	3	4	0	0	0	0	7
1996-2000	2	8	1	0	0	0	11
2001-2005	8	9	1	0	1	0	19
2006-2010	13	9	4	1	1	1	29
2011-2015	8	7	3	1	0	0	19
2016-2022	5	3	7	0	0	0	15
Total	39	40	16	2	2	1	100

#### Table 6: Document-wise authorship pattern.

Docs Type	One	Тwo	Three	Four	Five	Fifteen	Total
	Author	Author	Author	Author	Author	Author	
Article	24	33	12	0	2	0	71
Book	2	0	0	0	0	1	3
Conference Paper	3	3	1	1	0	0	8
Editorial	0	1	0	1	0	0	2
Note	6	0	2	0	0	0	8
Review	4	3	1	0	0	0	8
Total	39	40	16	2	2	1	100

#### Table 7: Degree of collaborations.

Year	Single Author (Ns)	Multiple Authors (Nm)	Ns+Nm	Degree of Collaborations (DC)
1991-1995	3	4	7	0.57
1996-2000	2	9	11	0.82
2001-2005	8	11	19	0.58
2006-2010	13	16	29	0.55
2011-2015	8	11	19	0.58
2016-2022	5	10	15	0.67
Total	39	61	100	0.61

## **Degree of Collaborations**

The research carried out in collaboration with Dr. Raghuram Rajan's publications is shown in Table 7. Compared to single-authored articles, multi-authored publications are more in prevalence.

In the study following formula given by K. Subramanian for degree of collaboration is used:

Degree of Collaboration (DC) =  $DC = \frac{Multiple Authors (Nm)}{Single Author (Ns)+Multiple Author (Nm)}$ 

Note:

DC=Degree of Collaborations

Nm=Multiple Author (61)

Ns=Single Author (39)

$$DC = \frac{61}{39+61} = \frac{61}{100} = 0.61$$

In consideration of this, the DC of Dr. Raghuram Rajan's publications from 1991 to 2022 is 0.61. In-depth analysis of this has been enumerated in the Table 7.

# **Scientific Productions by Country**

The scientific output of the country is shown Figure 7 in terms of the Dr Rajan's publications in concerned was created using the "Biblioshiny" programme and RStudio. Different productivity rates are shown by the depth of the blue colour; for example, dark blue implies high productivity. The countries associated with Dr. Rajan's papers are shown in the Figure 7. This analysis gives a

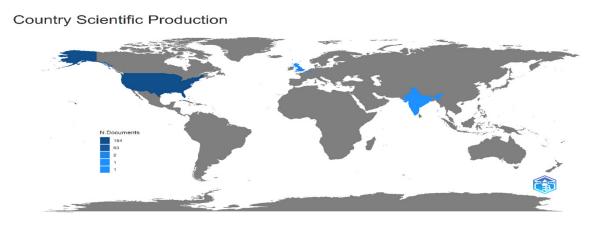


Figure 7: Scientific productions by country (generated by "Biblioshiny" in RStudio).

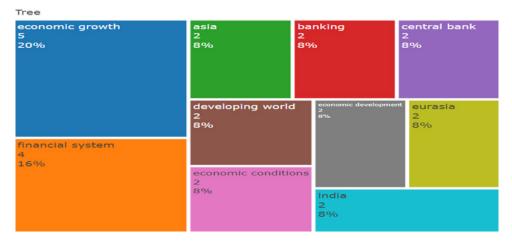


Figure 8: Top ten keywords mapping (generated by "Biblioshiny" in RStudio).

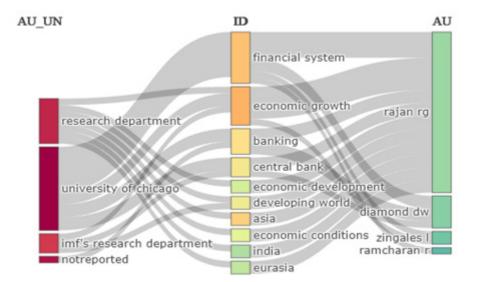


Figure 9: Research topics network (generated by "Biblioshiny" in RStudio).

general picture of the research and collaborative communities. Units of analysis include countries and authors. Authors of only four nations have as associates: the USA (with the highest number), the UK (with the second-highest), followed by Belgium and India.

## **Keywords Mapping**

Figure 8 describes the top 10 keywords used by Dr Rajan in his publications are listed out. 'Economic growth' was the top keyword with occurrences of (5, 20%), 'financial system' (4, 16%), Asia, banking, central bank, developing world, economic conditions,

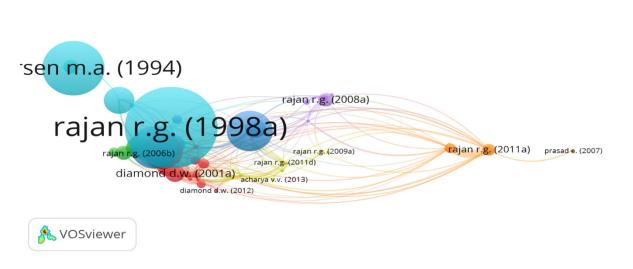


Figure 10: Bibliographic coupling with documents (generated by VOSviewer).

economic development, Eurasia, India-all these keywords are (2, 8%) in terms of occurrence in Rajan's literature.

#### **Topic Analysis**

In terms of collaboration between academics from various institutions, Figure 9 shows that the University of Chicago, the Research Department, and the IMF Research Department had the maximum levels of alliance and, as a result, the greatest network of papers involving co-authors. A Three-Field Plot (Sankey diagram) is a visual representation of this data that enables visualisation of the most important organisations, subjects (keywords Plus), and authors in terms of inter-institution collaboration. The graph below shows the frequency of a certain institution, keyword, or author inside the collaboration network as a function of the size of the coloured rectangles. Additionally, The number of connections also influences the thickness of the connection nodes, which are the links between institutions, keywords, and authors. (Guleriaand Kaur, 2021, pp. 1989-2019).

#### **Bibliographic Coupling with Documents**

Figure 10 visualises the bibliographic coupling of documents of Dr Rajan's publications. The overall strength of the bibliographic coupling relationships between each of the 72 documents are determined. The documents having the strongest overall linkage are chosen. According to this graph, Dr Rajan has the highest TLS (Total Link Strength), which is followed by Kashyap, A.K.A., Kroszner, Diamond, and so forth.

# **CONCLUSION AND KEY FINDINGS**

This study creates a scientometric portrait of Dr. Raghuram Rajan's publications that include 100 works from the year 1991 to 2022, or over 39 years, and are indexed in the Scopus database only. His mastery in economics, econometrics, and finance can be inferred. Most of his scientific discoveries were released through the publications in 2006 (14), 2011 (9) and 2005 (8). His overall

number of publications has an annual growth rate of 4.57 percent, i. e. 14.8 document on an average; the average number of citations per document is 265.8, and the total number of references is 3017. Besides in the field of Economic, econometric, and financial research accounted for most of the research effort, social science researchers also expressed considerable interest. As per the data collected, the USA and the UK toped in terms of publications and networks of international collaboration. Most research studies were reveals as articles, followed by conference papers, notes, reviews, books, and editorials coming in close succession. The biblioshiny network analysis of terms, "economic growth" came out on top, followed by "finance system," "Asia," and "banking "As he gathered more experience of works in economic related fields, he did more academic, and research works. With the use of biobibliometric research, it is possible to identify the cycle of knowledge formation and development at various stages by analysing the profiles of specific researchers across time. Additionally, to determine an impact study of a topic, it is occasionally essential to compile studies of numerous individuals who were contemporaneous with one another and who lived in various eras.

#### **CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest.

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