A bibliometric analysis of the global value chains research field

Matić, Ivan; Sunjka, Nikola

A BIBLIOMETRIC ANALYSIS OF THE GLOBAL VALUE CHAINS RESEARCH FIELD

Ivan Matić[*]

Nikola Sunjka[**]

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Abstract

This paper presents a bibliometric analysis of the global value chains (GVC) research field. To identify the most influential authors and contributions, potential collaboration networks, most discussed topics, and areas of further research opportunities within or related to the GVC research field, we applied the five most common bibliometric methods, namely citation, co-citation, co-author, and co-word analysis, and bibliometric coupling method. Our dataset for quantitative analysis of available articles, authors, and publication outlets in the GVC research field includes 2,506 articles, book chapters, books, and conference papers from 1,047 different sources in the Web of Science database published between the years 1999 and 2021. Our analysis provided a structured and thorough bibliometric overview of the GVC research field, including the years of the COVID -19 pandemic. The results show that the most frequently researched topics include GVC governance, trade, innovation, and production networks. We also identified future GVC-related bibliometric research streams, such as linking GVCs to international sourcing, corporate functions, and firm performance.

Keywords: *global value chains, bibliometric analysis, bibliometric methods, Web of Science database*

1. INTRODUCTION

Today's global economy is characterized by a complex structure, the fragmentation of many production processes, and their global relocation. It is dominated by trade in intermediate goods and services integrated into global value chains (Gereffi, 2018). In a 'GVC world' where countries at all levels of development are highly interconnected (McWilliam et al., 2020), the debate about GVCs and how they operate has become extremely important, leading to a growing literature on GVCs (Mayer & Phillips, 2017). The COVID-19 pandemic and sustainability demands are shifting the focus of policymakers, researchers, and the public from analyzing international trade, within or without the GVC context (ADB et al., 2021; Arriola et al., 2020).

* Ivan Matić (Corresponding author), PhD, Associate professor, Faculty of Economics, Business and Tourism, University of Split, Cvite Fiskovića 5, 21000 Split, Croatia, Phone: +385 21 430 741, Email: imatic@efst.hr

** Nikola Sunjka, PhD candidate at Faculty of Economics, Business and Tourism, University of Split, Eurostat, Statistical officer, Phone: +352 691 127 406, E-mail: nikola.sunjka@gmail.com

GVCs represent a way to organize the production of goods and services globally (Eurostat, 2021). These GVCs encompass a range of activities or tasks required to take a product or service from conception to market and beyond (Gereffi & Fernandez-Stark, 2016; Sturgeon, 2013). Based on Gereffi and Korzeniewicz (1994), the phenomenon of organizationally fragmented international production has been studied in a variety of academic disciplines, including economic sociology, international economics, regional and development studies, economic geography, international political economy, supply chain management, international business (IB), and operations management (Kano et al., 2020).

The first papers exploring GVCs were published in mid to late 1990. At that time, however, these GVCs were usually referred to as commodity chains, although in practice, the concepts of GVCs and global commodity chains function almost identically (Dess et al., 1996; Gereffi, 1994, 1999a; Talbot, 1997). The driving force behind this initial research was the rapid expansion of outsourcing abroad, especially in labor-intensive industries (Gereffi, 1999b), and the rapid increase in competition among companies in a globalized world (Humphrey & Schmitz, 2000).

The second wave of literature began in the early 2000s and shifted focus from describing the activities and motivations for participating in GVCs to assessing the forms of GVC governance (Gereffi et al., 2005; Ponte & Gibbon, 2005) and modernization in industry clusters (Giuliani et al., 2005; Humphrey & Schmitz, 2002). In addition, this literature examined the performance of companies in GVCs (Dedrick et al., 2011), particularly concerning innovation (Pietrobelli & Rabellotti, 2010). This stream of literature continued to focus on similar themes (Gereffi, 2014; Timmer et al., 2014) but also reviewed the original GVC theories that attempted to explain the organization of GVCs (Los et al., 2015; Ponte & Sturgeon, 2014; Yeung & Coe, 2015).

As a result of the COVID-19 pandemic that began in 2020, we can expect a new stream of literature focused on market shocks, de-globalization, and the shortening of GVCs (Antràs, 2020; Arora et al., 2021; Pla-Barber et al., 2021). In a decade of de-globalization and mainstreaming of sustainability, coupled with COVID-19 pandemic consequences, GVCs will change significantly. At the same time, the GVC literature is expected to undergo a significant transformation, underscored by a greater engagement of scholars in interdisciplinary research that combines perspectives from international business, international finance and economics, international investment law, and development studies (Zhan, 2021).

In more than two decades of developing the GVC research field, especially in recent years, several literature reviews have been produced indicating that the importance of the research field is increasing. Hernández & Pedersen (2017) reviewed the GVC literature focusing on GVC configuration and provided an analysis of the decisions involved in the GVC configuration, the chosen modes of governance, and the modes of configuration. In addition, these authors emphasized some outcomes of GVC configuration, such as the impact on performance or upgrading through chains. The authors highlighted two areas for future research opportunities: (1) further quantitative analysis of GVC configuration and the factors that influence it, and (2) broaden the GVC perspective by analyzing the relationships between transactions and activities at the entire GVC level. Kano et al. (2020)

conducted a literature review focusing on critical GVC governance issues at the micro and macro levels. This review provided an analysis of potential future research avenues, mainly related to the motivations and behaviors that lead to participation in GVCs and the design of their governance, as well as the need to develop GVC mapping further, i.e., to identify and describe the relationships among GVC participants, their roles, and the elements of GVC. De Marchi et al. (2020) conducted a systematic review of the GVC literature to identify overlaps with the international business literature. The paper describes the evolution and development of GVC research over the period 1994-2018, focusing on work that has synergies with the IB literature. Finally, the authors identified research opportunities in common GVC elements (governance, upgrading, institutional context, and industrial and geographic scope), for some of which they employed bibliometric methods (citation analysis).

To date, quantitative bibliometric analysis has rarely been conducted within the already sparse research literature on GVC. This analysis is critical in providing insight into future research opportunities, identifying research networks, and bringing objectivity to the research field (Zupic & Čater, 2015). A modest number of published literature reviews provide analysis of the GVC field, but these works have limitations. These limitations include providing only a comparative analysis of the GVC field without using advanced bibliometric methods (De Marchi et al., 2020; Hernández & Pedersen, 2017; Kano et al., 2020) or using only a limited number of bibliometric methods, such as only citation analysis and co-occurrence analysis (Filimonova et al., 2017) or citation, co-citation, and co-occurrence analysis (Liu & Mei, 2016). In addition, some papers have limitations because they focus only on specific GVC subtopics, such as innovation systems and GVCs (Jurowetzki et al., 2018), industry clusters and districts in GVCs (González-Torres et al., 2020), and agricultural labor in GVCs (de Souza et al., 2021). To overcome the limitations of the above reviews, this paper provides new bibliometric research that includes a broader range of bibliometric methods, i.e., citation, co-citation, co-author, co-word, and bibliographic coupling. By applying these methods simultaneously-an approach not previously used in this research area-and incorporating the contributions of the COVID-19 era literature, this paper offers valuable new insights into the current state of GVC research and its future research directions.

Consequently, new bibliometric studies covering a broader range of bibliometric methods (citation, co-citation, co-author, co-word, and bibliographic coupling) not previously used simultaneously in this research area and covering the contributions of the literature of the COVID -19 era should provide valuable insights into the current state of the GVC research field and its future research directions.

The paper is organized as follows. Section 2 describes the methodology used for the bibliometric analysis, while Section 3 presents the results of the five bibliometric methods applied. Section 4 summarizes the main findings and conclusions from the analysis and suggests avenues for further research opportunities. Finally, Section 5 presents the main limitations of our analysis.

2. BIBLIOMETRIC METHODOLOGY

2.1. Bibliometric analysis and methods

Bibliometric analysis is an objective and quantitative analysis of the bibliographic data of scholars working in a particular field. Although bibliometric methods are not new (Kessler, 1963; Small, 1973), their use has increased with the increasing capabilities of modern technology (Bar-Ilan, 2008). Bibliometric methods help draw conclusions based on aggregate bibliographic data from other scholars in the field, including citations, collaboration information, and abstracts. Analysis of these bibliographic data can provide valuable insights into the research field, social networks, and recent trends in the field (Zupic & Čater, 2015). Depending on the desired outcome of the analysis, different methods can be used, the most critical being citation, co-citation, co-authorship, co-word method, and bibliographic coupling (Zupic & Čater, 2015). To perform a detailed bibliometric analysis, these five most commonly used bibliometric methods are presented, including some additional methods that are appropriate for the bibliographic dataset in the GVC field and contribute to a better understanding of this field.

Citation analysis describes the relationship between the cited and the citing document and is the most commonly used bibliometric method (Smith, 1981). The primary purpose of citation analysis is to evaluate scholars, publications, and institutions, show a particular field's historical development, and search and retrieve bibliographic information (Zunde, 1971). Conceptually, co-citation analysis and bibliographic coupling can be considered subcategories of citation analysis (Nicolaisen, 2007*). Co-citation analysis* describes how often two documents are cited simultaneously (Small, 1973). This analysis estimates the similarity between articles and identifies clusters of concurrently cited articles (Boyack & Klavans, 2010). *Bibliographic coupling* is one of the oldest bibliometric methods, first introduced by Kessler (Kessler, 1963). This method aims to estimate the strength of the coupling between two documents, defined by the number of shared references. Unlike co-citation analysis, which estimates the simultaneous citation of two documents, bibliographic coupling counts the frequency of citation of the same third document by two documents (Egghe & Rousseau, 2002).

Co-author analysis is often used to identify a particular research field's intellectual and social structure by analyzing the collaboration between authors (Price & Beaver, 1966). This analysis often succeeds in identifying an "invisible college" (Crane, 1972) consisting of authors who frequently collaborate and share similar scholarly interests even though they do not belong to the same formal institutions (Zuccala, 2006). Finally, the *co-word analysis* estimates the co-occurrence of phrases or keywords in articles (Callon et al., 1991) to identify thematic connections in the research field (He, 1999).

2.2. Bibliometric analyses in the GVC research field

In the field of GVC research, several papers stand out as bibliometric analyses. In this sense, Liu & Mei (2016) conduct a bibliometric analysis of the GVC research field, focusing on the historical development of the research field during 1995-2014, aiming to define and describe the

intellectual structure of the field and identify future research opportunities. They conducted a co-occurrence network analysis to identify disciplines closely associated with GVCs, a co-word analysis that helped them identify future research opportunities, and a co-citation analysis that identified four major co-citation clusters. The results of this study are comprehensive. They show the most productive years of research and identify the most influential authors and articles. However, the paper does not include articles published between 2015 and 2021 and does not perform a co-author analysis or the bibliographic coupling method.

Filimonova et al. (2017) analyzed research trends in the GVC literature during 2006-2014 and used a bibliometric analysis to identify future practical research opportunities for the Russian economy. The authors identify the authors' countries of origin and production, the distribution of disciplines of origin, and use citation and co-citation analysis to identify five fronts for future research and five research gaps specific to the Russian literature. Although the paper identified research opportunities and gaps, it did not use comprehensive bibliometric methods and focused only on providing results useful for advancing Russian research on GVCs.

Jurowetzki et al. (2018) examined the link between national innovation systems and GVC literature using bibliometric analysis and a qualitative literature review. For this purpose, they use citation analysis, namely the bibliographic coupling method, which aims to capture cases where two papers refer to a third common paper. The authors conclude that further research is needed to link national innovation systems to various elements of GVCs, including the local and national institutional context and the role of government in linking these elements. Although this paper describes linking the issues of national innovation systems and GVCs, it uses only one bibliometric method to describe this link.

González-Torres et al. (2020) analyzed the relationship between industry clusters and GVC literature using bibliometric citation, co-citation, and co-word analysis, along with assessing literature productivity and impact metrics. These authors sought to answer questions about the historical development of the literature, the productivity of authors and journals, the most influential articles and journals, and the common themes of industry clusters and GVC literature. The common themes were identified in three areas: (1) global value chains, (2) innovation, and (3) clusters, indicating a strong connection between the themes. In conclusion, the authors point out that due to the changing environment of the COVID -19 world, further bibliometric research is needed, and future research should be able to shed new light on the topic as the relevant literature proliferates.

De Souza et al. (2021) studied and analyzed the literature on agricultural labor in GVCs using a bibliometric analysis, for which they selected 324 articles published between 2000 and 2019. The authors used a citation and co-word analysis to identify the intellectual structure and most influential articles, institutions, authors' countries of origin, and journals in the field. The paper identified three research areas, namely (1) socioeconomic aspects of labor in value chains, (2) the impact of global value chains on labor, and (3) the technological development of global value chains. The same authors conclude that collaboration among authors from different institutions was prevalent among the most influential authors, underscoring the importance of the "invisible university." At the same time, they note

that the scope of the bibliographic database could be expanded by using other databases to analyze the link more thoroughly between the literature on agricultural labor and GVCs.

2.3. Selected bibliometric approach

The main objective of our bibliometric analysis was to perform a systematic and critical analysis and classification of recent theoretical and practical achievements in the field of GVC research. To perform a quantitative and objective analysis of the available papers, authors, and publication media in the field of GVC research, we decided to use the five most common bibliometric methods, namely citation, co-citation, co-author and co-word analysis, and bibliometric coupling method. For the bibliometric analysis, we collected data from one of the most popular repositories for scientific literature, the World of Science (WoS). We considered only English-language articles published between 1999 and 2021 that contained the keyword phrase "global value chain*." The dataset included 2,506 papers consisting of 1,921 articles, 207 book chapters, 19 books, and 359 conference proceedings from 1,047 different sources. The data include a total of 84,741 citations and 5,869 authors. We used the Biblioshiny for bibliometrix packages and the "R" software for the bibliometric analysis.

Over the period studied from 1999 to 2021, the number of published papers increased by an average of 28.87%, with the most significant increase in new papers between 2012 and 2018, as shown in Figure 1. In the last four years alone, the number of publications has increased by an average of 350 per year, reflecting the increasing interest of academics in the GVC research field and highlighting the need for a thorough and objective analysis of the field itself.

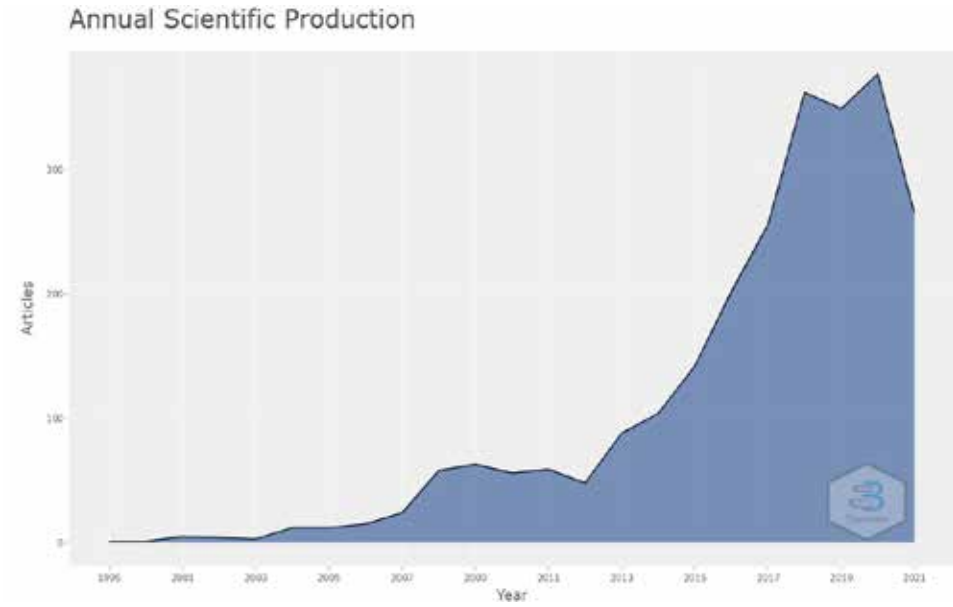

Figure 1. Annual growth in the number of papers on global value chains

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

3. RESULTS

3.1. Citation analysis

First, we analyzed the most cited papers in the field of GVCs to determine which papers (articles, book chapters, books, and conference proceedings) have the most significant impact. Based on the total number of citations in the Web of Science collection, the most cited papers are as follows: The governance of global value chains (Gereffi et al., 2005), How does insertion in global value chains affect upgrading in industrial clusters? (Humphrey & Schmitz, 2002), and Upgrading in Global Value Chains: Lessons from Latin American Clusters (Giuliani et al., 2005). At the same time, these three papers are among the five most cited in the Web of Science collection when we look at the average annual number of citations, as shown in Table 1. The overview of the ten most cited papers shows that the subject areas within the GVC research field are very diverse: management (two papers), innovation (one paper), ways to engage in GVCs (one paper), enterprise improvement (one paper), and general, i.e., broad analysis of GVCs (five papers).

Table 1. The most cited papers, according to the Web of Science collection

Authors	Paper	Number of citations	The average annual number of citations
Gereffi, G., Humphrey, J., & Sturgeon, T.	The governance of global value chains	2,695	159
Humphrey, J., & Schmitz, H.	How does insertion in global value chains affect upgrading in industrial clusters?	1,047	52
Giuliani, E., Pietrobelli, C., & Rabellotti, R.	Upgrading in Global Value Chains: Lessons from Latin American Clusters	454	27
Ponte, S., & Gibbon, P.	Quality standards, conventions and the governance of global value chains	418	25
Sturgeon, T., Van Biesebroeck, J., & Gereffi, G.	Value chains, networks and clusters: reframing the global automotive industry	362	26
Gereffi, G.	Global value chains in a post-Washington Consensus world	331	41
Timmer, M. P., Erumban, A. A., Los, B., Stehrer, R. & de Vries, G. J.	Slicing Up Global Value Chains	281	35
Pietrobelli, C., & Rabellotti, R.	Global Value Chains Meet Innovation Systems: Are There Learning Opportunities for Developing Countries?	278	25
Gibbon, P., Bair, J. & Ponte, S.	Governing global value chains: an introduction	277	20
Yeung, H. W.-C., & Coe, N. M.	Toward a Dynamic Theory of Global Production Networks	245	35

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

The most prolific authors in the field of GVC (Table 2) are Gereffi, G. (32 contributions), Ponte, S. (32 contributions), Lund-Thomsen, P. (19 contributions), Nadvi, K. (18 contributions), and Di Maria, E. (16 contributions). The most cited authors are Gereffi, G. (1,740 citations), Humphrey, J. (1,618 citations), Sturgeon, T. (1,169 citations), Ponte, S. (896 citations), and Schmitz, H. (685 citations). According to the H- index, the most influential authors are Ponte, S. (H-index 15), Nadvi, K. (H-index 13), Gereffi, G. (H-index 12), Pietrobelli, C. (H-index 10), Rabelloti, R. (H-index 9), Barrientos, S. (H-index 8), and Lund-Thomsen, P. (H-index 8). Considering the differences between the most prolific and the most cited authors, the number of articles published does not necessarily correspond to the quality or usefulness of these articles. Only Gereffi, G., Ponte, S., Nadvi, K., Pietrobelli, C., and Rabelloti, R. are simultaneously among the ten most productive and the ten most cited authors. It is important to note that Gereffi, G. is an author whose influential papers in the observed field were published before 1999 (mostly related to global commodity chains), outside the research years. Therefore, his influence is somewhat underestimated, even though he is still the most prolific and cited author.

Table 2. The list of the most productive and most cited authors

Author	Number of papers	Author	Number of citations	Author	H-index
Gereffi, G.	32	Gereffi, G.	1,740	Ponte, S.	15
Ponte, S.	32	Humphrey, J.	1,618	Nadvi, K.	13
Lund-Thomsen, P.	19	Sturgeon, T.	1,169	Gereffi, G.	12
Nadvi, K.	18	Ponte, S.	896	Pietrobelli, C.	10
Di Maria, E.	16	Schmitz, H.	685	Rabellotti, R.	9
De Marchi, V.	15	Rabellotti, R.	522	Barrientos, S.	8
Pietrobelli, C.	15	Pietrobelli, C.	514	Lund-Thomsen, P.	8
Mudambi, R.	14	Nadvi, K.	439		
Rabellotti, R.	14	Gibbon, P.	377		
Barrientos, S.	13	Timmer, M. P.	335		

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Next, we looked at the country of origin of the authors. We found that most of the papers were written by authors from China (465 papers), the United Kingdom (267 papers), the United States (241 papers), Italy (125 papers), and Germany (119 papers), as shown in Table 3. The only developing country besides China whose authors contribute significantly to the literature on GVCs, is Poland (ranked 13th in Table 3).

Table 3. Number of papers by country of origin of the author

	Country	Number of papers	Share in the total number of papers	Number of papers with authors from the same country (SCP)	Number of papers with authors from different countries (MCP)
1	**China**	465	19.0%	376	89
2	**Great Britain**	267	10.9%	156	111
3	**USA**	241	9.8%	160	81
4	**Italy**	125	5.1%	79	46
5	**Germany**	119	4.9%	81	38
6	**Netherlands**	94	3.8%	55	39
7	**Denmark**	91	3.7%	47	44
8	**Spain**	72	2.9%	59	13
9	**Australia**	71	2.9%	48	23
10	France	63	2.6%	39	24
11	**South Korea**	62	2.5%	51	11
12	**Japan**	54	2.2%	39	15
13	**Poland**	52	2.1%	46	6
14	**Canada**	45	1.8%	28	17
15	**Belgium**	41	1.7%	19	22

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Most papers on GVCs were published by authors from Copenhagen Business School (83 papers), the University of Manchester (78 papers), Duke University (62 papers), the University of Sussex (53 papers), and Wageningen University (42 papers), as shown in Table 4. However, we noticed that only one Chinese university is on the list of the ten most productive universities (University of International Business and Economics), although the authors from China are the most productive. We explain this because China is represented by authors from many different Chinese universities who have written between 4 and 8 papers, unlike authors from other countries who are commonly concentrated in only a few top universities. The list of the most influential institutions and the authors' countries of origin suggests that GVCs are primarily analyzed in developed countries, except China.

Table 4. Ranking universities by the number of published papers

University	Number of papers
Copenhagen Business School	83
University of Manchester	78
Duke University	62
University of Sussex	53
Wageningen University	42
University of Padua	41
National University of Singapore	37
University of International Business and Economics	37
University of Groningen	31
University of Cape Town	27

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Most articles were published in the following journals: Sustainability (57 articles), World Economy (45 articles), World Development (44 articles), Review of International Political Economy (37 articles), and the book Handbook on Global Value Chains (34 articles) (Table 5). However, the primary sources are very different when we look at the publication media by the number of citations (Table 6). Consequently, most articles cite literature from World Development (3,320 citations), Review of International Political Economy (2,051 citations), Journal of International Economics (2,009 citations), Journal of International Business Studies (1,959 citations), and American Economic Review (1,941 citations). The observed difference in the number of articles published and their continued citation suggests that the number of articles published is not necessarily indicative of their importance to the field observed. For example, 34 articles published in the Handbook on Global Value Chains were cited only 53 times, while 44 articles published in World Development were cited as many as 3,320 times. The diversity of topics covered by the publishing outlets suggests that the field of GVCs is broad and multidisciplinary. The most influential publishing outlets publish articles in the research areas of sustainability, world development and economics, regional economics, political, international, and international business economics, geography, strategic management, and business ethics.

Table 5. Number of papers by publishing outlets

Publishing outlet	Number of papers
Sustainability	57
World Economy	45
World Development	44
Review of International Political Economy	37
Handbook on Global Value Chains	34
Competition & Change	32
Journal of Cleaner Production	32
European Journal of Development Research	29
European Planning Studies	26
Journal of Economic Geography	26

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Table 6. Number of citations by publishing outlets

Publishing outlet	Number of citations
World Development	3,320
Review of International Political Economy	2,051
Journal of International Economics	2,009
Journal of International Business Studies	1,959
American Economic Review	1,941
Journal of Economic Geography	1,710
Resources Policy	1,510
Regional Studies	1,374
Strategic Management Journal	1,238
Journal of Business Ethics	1,123

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

3.2. Co-citation analysis

Co-citation analysis is one of the most commonly used methods of bibliometric analysis (Ding et al., 2001). This method refers to the simultaneous citation of two articles. If two articles are frequently cited at the same time, these articles probably have something in common (Benckendorff & Zehrer, 2013). This method is most commonly used to detect the clustering of co-cited articles and to gain insight into the intellectual structure of the observed domain (Leung et al., 2017; Pasadeos et al., 1998). Considering that we found 84,741 citations in this bibliometric study, the analysis of co-citations for the entire set of citations would not provide meaningful results. Therefore, we included only the 50 most frequently co-cited articles in our analysis. We identified three clusters of co-cited articles. The size of the circles indicates the

normalized number of citations per article, and the lines connecting the articles indicate all co-cited articles. For simplicity, each circle is labeled only with the last name and initials of the first author and the year of publication (Figure 2).

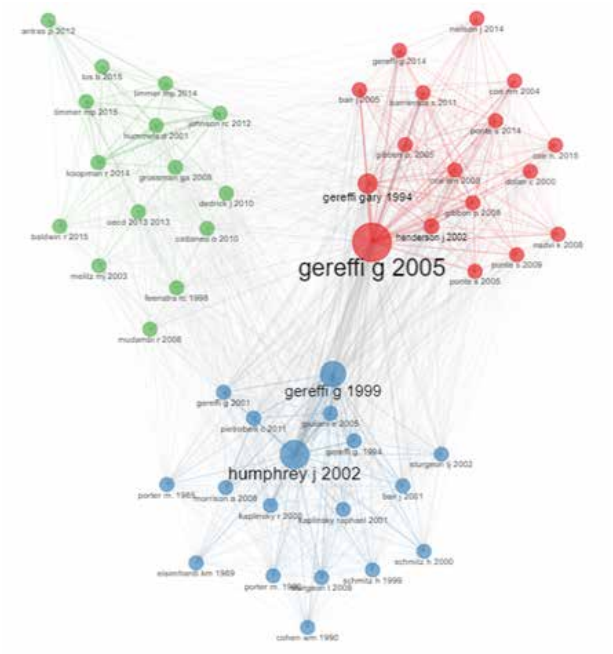

Figure 2. Co-citation analysis of the GVC field
Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

The first cluster includes 17 contributions, five by Ponte, S., four by Coe, N. M., Gereffi, G., and Yeung, H. W. C., and three by Dicken, P., and Hess, M. Most of the contributions deal with the study of management (6 contributions), the structure and organization of global production networks (5 contributions), and the economic and social upgrading of enterprises within GVCs (3 contributions).

The second cluster includes 18 contributions, five of which were published by Gereffi, G. and three by Schmitz, H. Since no other author appears in more than two papers, we conclude that the authorship of the papers in this cluster is more diverse than in the first cluster. At the same time, the topics of the contributions are somewhat more diverse than in the first cluster. Most of the contributions deal with the general characteristics of GVCs (5 contributions), industrial clusters (3 contributions), the impact of participation in GVCs on firms' learning opportunities and innovation levels (3 contributions), and modes of participation in GVCs (2 contributions).

The third cluster includes 15 contributions, of which the author de Vries, G. J., appears in three. Since no other author appears in more than one contribution, we conclude that this cluster is the most diverse of the three clusters in terms of authorship of contributions. In addition, this cluster contains some very influential papers, such

as Koopman et al. (2014), Timmer et al. (2014), and Los et al. (2015). Most of the papers deal with the modalities of participation in GVCs and the organization of tasks between companies in the chain (7 papers), as well as the impact of participation in GVCs on companies' innovation levels (2 papers).

3.3. Bibliographic coupling

Bibliographic link is one of the newer bibliographic methods to observe new topics in scientific research (Glänzel & Thijs, 2012). Applying this method, we identified four articles clusters, shown in Figure 3. In the application, the "paper," measured by the number of local citations, was used as the unit of analysis, and the labeling was based on keywords from the papers. The analysis includes 500 of the most cited articles with a minimum cluster frequency of 1‰ and seven keywords per cluster. "Governance" is a keyword in all four clusters, and "innovation" is a keyword in three clusters. Two clusters mention words related to performance other than innovation, namely the words "performance," "productivity," and "growth," to which the word "impact" can be added because it is often associated with measuring performance. To find potential research areas, we thought it appropriate to observe a cluster that uses the words: trade-governance-FDI-innovation-productivity-growth-GVC. Indeed, this cluster is the least central and has the lowest impact, i.e., this literature is the least cited.

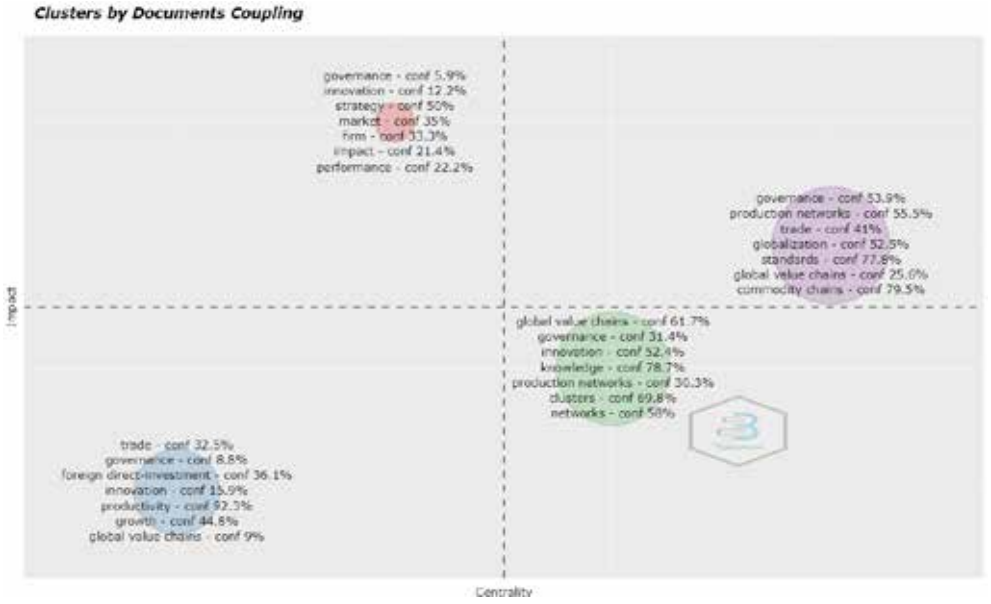

Figure 3. Bibliographic coupling of papers presented in clusters

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

3.4. Co-author analysis

The analysis of co-authorship should shed light on whether authors from different disciplines collaborate, what collaboration looks like in the field, and what the social structure in the field looks like (Zupic & Čater, 2015). Therefore, we analyzed the collaborative network using the Louvain cluster algorithm, considering the 50 most cited articles. After this analysis, authors for whom no link to other authors was found were excluded, and 28 authors formed a collaborative network in the field in seven clusters shown in Figure 3. As expected, the largest cluster includes authors collaborating in the field of GVC governance (e.g., Gereffi, G., Ponte, S., and de Marchi, V.), followed by a cluster focusing on social responsibility and industrial clusters (e.g., Nadvi, K. and Lund-Thomsen, P.), and a cluster focusing more on industrial modernization and innovation in GVCs (e.g., Pietrobelli, C. and Rabellotti, R.).

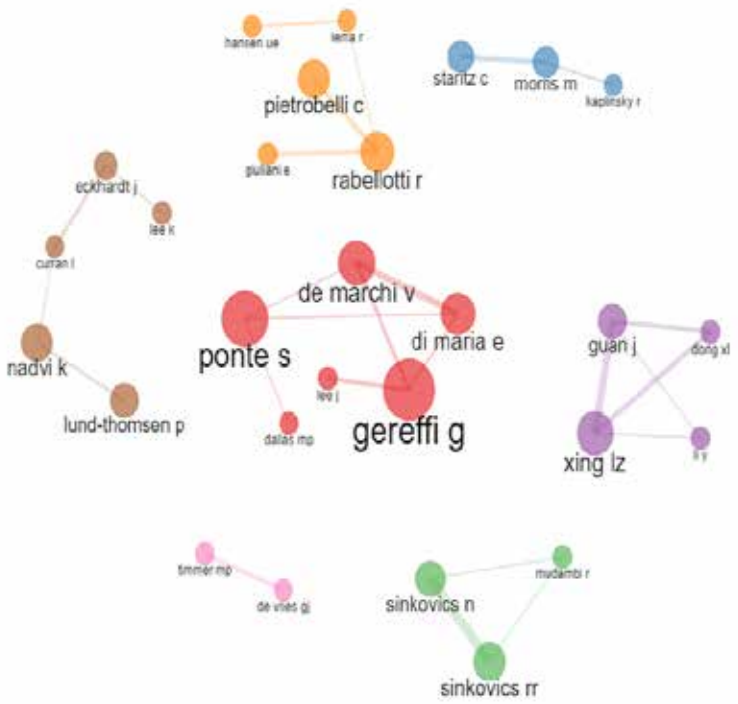

Figure 4. A network of collaboration among authors

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

The collaboration network of the 30 most cited authors by country of origin, shown in Figure 5, reveals only two collaboration clusters. As expected, authors of European origin collaborate more with other European authors. However, it is interesting to note that the second cluster includes countries from different parts of the world, highlighting the close collaboration of authors from the United States and

China. In addition, authors from the United Kingdom collaborate more with U.S. authors, Czech authors are closer to U.S. and Japanese authors than other European authors, and South African, Brazilian, and Indian authors join the cluster of European authors with strong ties to British authors.

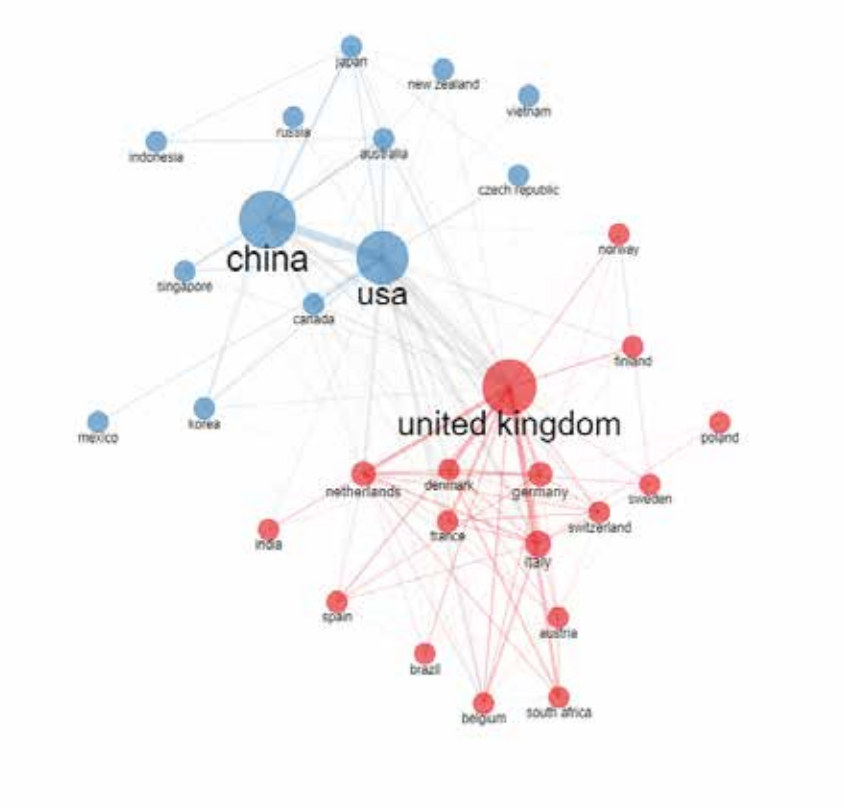

Figure 5. Collaboration of authors by country of origin

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

3.5. Co-word analysis

Co-word analysis looks for words that occur together in an article. Applying this method, we found three clusters containing common keywords, as shown in Figure 6. These three clusters, i.e., networks of topics and their relationships, represent the conceptual space of the GVC research field.

The first cluster (green) focuses on the impact of GVC participation on international trade, growth, and productivity and often includes work that uses foreign direct investment as a measure of GVC participation (Barber, 2008; Beugelsdijk et al., 2009; Brancati et al., 2017; Buckley & Strange, 2015; Giuliani et al., 2005; Murakami & Otsuka, 2017; Pietrobelli & Saliola, 2008). The second cluster (red) includes research on the impact of participation in GVCs on innovation, research and development, and performance, with a focus on observing the knowledge acquisition and learning that companies can achieve through

participation in GVCs (Baldwin & Okubo, 2019; Brancati et al., 2015, 2021; Buciuni & Pisano, 2021; Gereffi, 2014; Keijser et al., 2021; Sturgeon & Gereffi, 2009). The third cluster (blue) denotes the portion of the literature that focuses on the governance of GVCs and the resulting organizational and market influences on enterprises in GVCs (Gereffi, 2014; Gereffi et al., 2005; Gibbon et al., 2008; Ponte & Gibbon, 2005; Yeung & Coe, 2015).

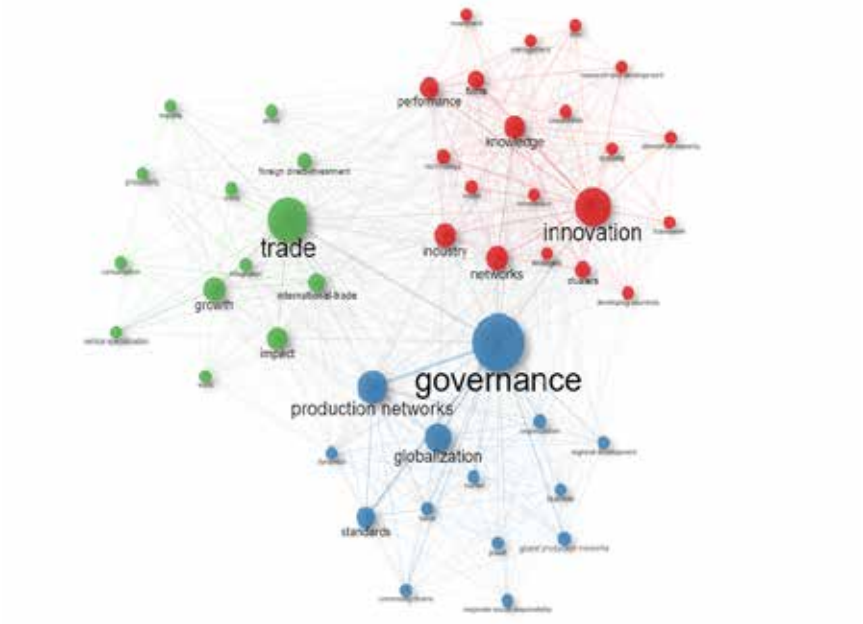

Figure 6. Co-occurrence of keywords

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Next, we performed a factorial analysis to facilitate the association of keywords and terms in the GVC research domain. This analysis visually represents the terms used together by grouping them into clusters. The terms are represented by points in a 2D plane, although the analysis is multidimensional (Rostaing, 2017). Consequently, delineating clusters helps to convey 3D connectivity more efficiently on a 2D plane. This factorial analysis is based on keywords in articles and shows 50 author keywords grouped into 5 clusters using multiple correspondence analysis, as shown in Figure 7.

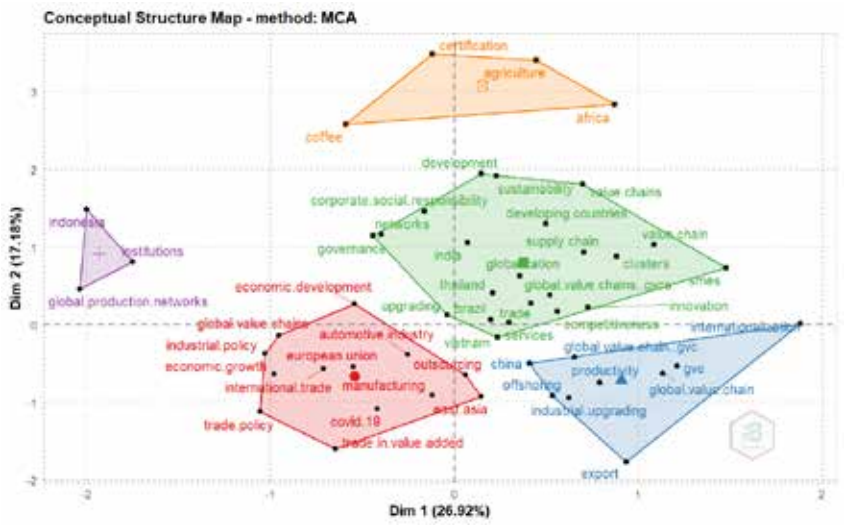

Figure 7. Factorial analysis - 2D display

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

Based on the factorial analysis, we developed a thematic dendrogram representing the most frequently used keywords (Figure 8). This branching structural representation highlights five major themes in the field of GVC research.

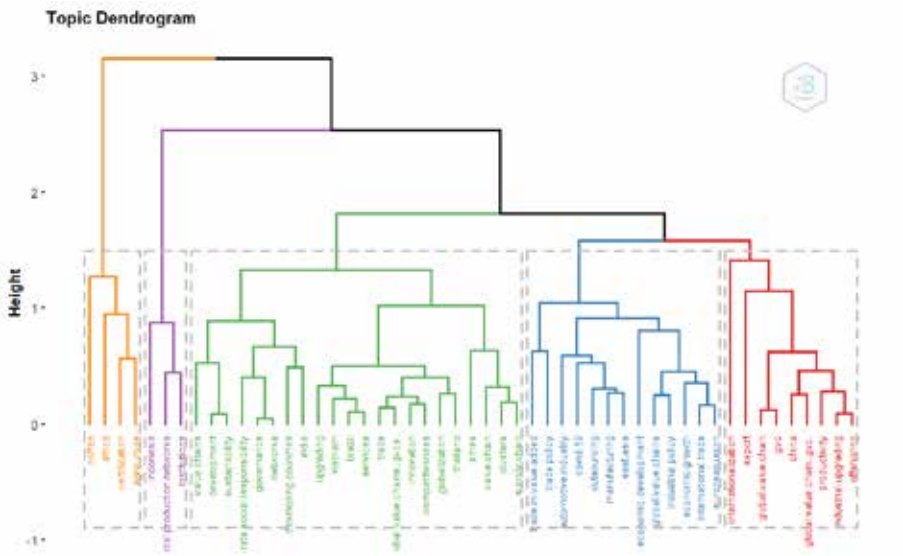

Figure 8. Factorial analysis - Topic dendrogram

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

The most frequently used keywords in the observed articles are "governance" (458 mentions), "trade" (388 mentions), "innovations" (261 mentions), "production network" (220 mentions), and "globalization" (188 mentions). Figure 9 shows the word cloud of the 40 most frequently used keywords in GVC research papers.

Figure 9. Word cloud of the 40 most used keywords in GVC research papers

Source: World of Science (WoS), software biblioshiny for bibliometrix, and programming package "R".

4. CONCLUSIONS

Our bibliometric analysis provides a quantitative and objective overview of the current state of GVC research and offers a good starting point for identifying future research opportunities. The annual production of papers in this area increased significantly after 2012, which speaks to the growing importance of studying different aspects of GVCs in the 'GVC world,' reinforced by sustainability requirements and the COVID-19 pandemic. Papers are mainly authored by authors from developed countries and China, while there is a lack of contributions from authors from developing countries. Possible reasons for the lack of contributions from developing countries include lower participation in GVCs, resulting from a lack of institutional and infrastructural improvements (OECD, 2015), or the lower quality and rank of universities in these countries, resulting in fewer citations of contributions. On the other hand, contributions from multiple disciplines (e.g., economics, politics, geography, ethics, and management) have been published in the media, leading to the conclusion that GVCs are of interest to multiple scientific disciplines and that the overall picture of the GVC field cannot be drawn by only one scientific discipline.

Co-citation analysis has shown that the authors can be divided into three major clusters. Apart from Gereffi, G., and Humphrey, J., few authors are particularly frequently cited. The papers "The governance of global value chains" (Gereffi et al., 2005) and "How does insertion in global value chains affect upgrading in industrial clusters?" (Humphrey & Schmitz, 2002) can be considered foundational readings in the field of GVC research in terms of the number of citations and influence on other work. At the same time, the most represented network of contributions and mutual citations is the collaboration network of authors Gereffi, G., Ponte, S., de Marchi, V.,

and di Maria, E. In addition, the largest network or triangle of collaboration is between authors from China, the US, and the UK.

This paper contributes to the GVC literature in three ways. First, we have taken a structured approach to the bibliometric analysis of the GVC research field and presented the results of the five most used methods, covering all significant aspects of bibliometrics. Second, we have covered the entire field of GVC research without filtering out other interactions, which would inevitably lead to a smaller scope of the literature. Finally, unlike other literature reviews, we use data from 2020 and 2021, the years of the COVID-19 pandemic. This major event is expected to affect the organization of international production and, consequently, GVCs due to the introduction of much international trade and movement restrictions.

5. LIMITATIONS AND FUTURE RESEARCH

One of the limitations of this paper is the limited search scope in the Web of Science database, where we used only the 'phrase global value chain*.' The scope of the literature would likely be more significant if other similar phrases, such as 'global production network*' or 'global commodity chain*,' had been included. However, only a more significant portion of the oldest literature would likely be covered, as the literature from 2005 onwards uses GVC terminology in most cases. This limitation also applies to the period covered (1999-2021), as the GVC terminology was only coined in the late 1990s. Furthermore, while the term global value chain* used has the advantage of capturing a broad spectrum of the GVC literature, it does not provide deep insight into specific related topics such as innovation, performance, clusters, and modernization. Further bibliometric research that sheds light on these relationships would be welcome.

Following the results of the bibliometric analysis presented earlier, we conclude that there is a well-defined basis for studying GVCs. However, the bibliographic coupling method has shown that there is space for additional research linking the concepts of trade, governance, FDI, innovation, productivity growth, and GVCs. It has been identified as the most promising future research area of the GVC field. On the other hand, a possible future bibliometric research direction would be to use the methods used in our paper to analyze more specific linkages in the GVC research area, such as GVCs and international sourcing, business functions, governance, innovation, firm performance, functional upgrading, and clusters. An essential future bibliometric research area is the analysis of the evolving literature measuring the COVID -19 impact on international production arrangements and GVCs, a landmark event for GVC research, and the subsequent introduction of new research streams in this area.

Finally, even though we use five different bibliometric methods, other techniques and tools could be used to analyze the literature further and provide additional meaningful information. In the future, applying the bibliometric methods in different periods, using other databases (e.g., Scopus), other bibliometric software (e.g., BibExcel and Sitkis), other grouping or visualization methods (e.g., MDS and network analysis), and other visualization software (e.g., UCINET and Pajek) could provide new and valuable insights into this research area.

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BIBLIOMETRIJSKA ANALIZA ISTRAŽIVAČKOG PODRUČJA GLOBALNIH LANACA VRIJEDNOSTI

Sažetak

U ovom se radu prezentira bibliometrijska analiza područja globalnih lanaca vrijednosti (GLC). Kako bi se utvrdili najznačajniji autori i publikacije, moguće suradne mreže, teme o kojima se najviše raspravlja i područja od interesa za buduća istraživanja unutar, ili povezana s istraživačkim područjem GLC-a, koristi se pet najčešćih bibliometrijskih metoda – analiza citiranja, ko-citiranja, koautorstva, povezanosti ključnih riječi i bibliometrijskih spojnica. Skup podataka za kvantitativnu analizu članaka, autora i publikacija u istraživačkom području GLC-a uključuje 2,506 članaka, poglavlja u knjigama, knjiga i konferencijskih radova, iz 1,047 različitih izvora u referentnoj bazi podataka Web of Science, objavljenih između 1999. i 2021. Ova analiza pruža strukturalni i opsežan pregled istraživačkog područja GVC-a, uključujući i godine pandemije Covida-19. Rezultati pokazuju da najčešće istraživane teme uključuju upravljanje GVC-ima, trgovinu, inovacije i proizvodne mreže. Također smo utvrdili i buduće teme istraživanja, koje se odnose na GVC-e, kao što su povezivanje GVC-a s međunarodnom nabavom, korporativnim funkcijama i rezultatima poslovanja.

Ključne riječi: *globalni lanci vrijednosti, bibliometrijska analiza, bibliometrijske metode, baza podataka Web of Science*