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A Bibliometric Analysis on CAMEL Model as a Tool for Measuring Financial Performance of Banks: Analyzing the Current Research Trends and Future Direction

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Abstract: The study was carried out to identify the main and emerging source, author, document, and theme, main co-occurrence network theme, gauge the degree of collaboration network of authors, institutions, and countries, and to find out the current trend and future scope of research in the study area.

Methodology: **The study extracted 114 documents following the PRISMA model from the Scopus database between 2003 and 2023. The dataset was analyzed using free Biblioshiny open software through R studio.**

Finding: **The study revealed that the Journal of Banking and Finance was the most prominent and influential journal followed by EuroMed Journal of Business and the Indian Journal of Finance. Whereas, the dominating and well-explored themes were CAMEL, CAMELS, liquidity, and capital adequacy. The dominance and significance of the theme evolved where before 2003 the dominant themes were financial performance, CAMEL, Islamic banks, and the banking industry which were shifted to new themes such as Islamic banks, corporate governance, financial soundness, liquidity, performance, banking sector, capital adequacy, and asset quality except CAMEL. The documents produced by M. Doumpos (2010), A. Derviz (2008) and U. Dang (2011) were the most relevant and significant papers in this field of study. Whereas authors: V. Kumar, W.-K. Wang and A. Makkar initially initiated the study and formed a cluster. 3 authors collaboration was the highest collaboration with only two clusters while the remaining cluster had only two authors collaboration. In terms of institutions, only one cluster represented two institutions namely the Federal University of Rio De Janeiro and the University of Malaya which were collaborating. 23 countries had contributed to this study. Country-wise Malaysia (4 collaborations) had the highest collaboration with other countries followed by India and Pakistan with 3 collaborations each.**

Originality/Value: **This study used data from the Scopus database.**

Practical Implication: **The result of this study will be significant to researchers, regulators, central banks, banks, and policymakers as it shows the current and future research trends.**

Keywords: Bibliometric analysis, CAMEL model, Current research trends.

I. Introduction

The Indian financial institution consists of commercial banks, cooperative banks, financial institutions, and non-banking financial companies (NBFC). As per Section 5(b) of the Banking Regulation Act, 1949, "banking" means the accepting, for the purpose of lending or investment, of deposits of money from the public, repayable on demand or otherwise, and withdrawable by cheque, draft, order or otherwise.

The bank is one of the important drivers of economic growth because there is a strong positive effect of banks on the real economy (Berger *et al.*, 2020) [1]. Tahir *et al.* (2015) [2] discovered that bank credit had an extensive association with economic growth in Pakistan; this relationship was also substantial in the short term. Nguyen (2022) [3] found that there is a nonlinear effect of banking development on economic growth. The threshold for bank credit is estimated to be around 101% of the GDP, suggesting that any further increase in the ratio

of bank credit to GDP beyond this threshold would negatively affect growth. Due to its importance, the banking sector has been making a rapid shift from the traditional way of doing to the use of artificial intelligence to improve client identification and verification, strengthen customer relationships, prevent and detect early fraud, and offer individualized insights and suggestions (Madhura and Panakaje, 2023) [4].

As banks are crucial to a nation's economic prosperity, it is vital to evaluate their performance. One of the key instruments suggested to assess the financial soundness of the banks is the CAMEL model which has five parameters: C- Capital adequacy, A- Asset quality, M- Management efficiency, E- Earning quality, and L- Liquidity. Using the CAMELS model shortens the investigation time by focusing on SIX parameters (Jothr *et al.*, 2021) [5]. The CAMEL model significantly impacts bank performance and helps measure the soundness of the banking sector (Qureshi and Siddiqui, 2023) [6]. The model parameters are among the most important and influential factors with regard to the Jordanian commercial banks (Amer, 2021) [7]. It can be concluded that the CAMEL model is the best model to evaluate the banks' financial performance, which will help reduce bank failure.

To further assess the relevancy of the CAMEL model, Bibliometric analysis is conducted to uncover the emerging trends, journal and author performance, collaborations, and main themes and to explore the intellectual structure of a specific domain (Donthu *et al.*, 2021; Verma and Gustafsson, 2020) [8] [9]. Over recent times, the bibliometric methodology has garnered immense popularity due to the presence of bibliometric software and databases that ease the acquisition of volumes of scientific data in business research (Donthu *et al.*, 2021) [8].

The procedures to conduct the bibliometric analysis are: define the aims and scope of the bibliometric analysis, choose the technique, collect the data, run the bibliometrics analysis, and report the findings (Donthu *et al.*, 2021; Linnenluecke *et al.*, 2020) [8] [10].

The study is divided into 6 sections including the present one, which depicts the introduction of the study. The research gap and objectives are presented in Section II and Section III. Section IV highlights the research methodology. Subsequently, Section V presents the data analysis and interpretation. The discussion and conclusion, scope, and limitation of the study are presented in Section VI followed by references.

II. Research Gap

Bibliometric analysis is a relatively new research method that has gained popularity in several fields including finance (Aysan and Nanaeva, 2022) [11]. Not even a single paper has been produced in this study area which makes it very difficult to identify the main themes, documents, authors, countries, and current trend. Moreover, it is also important to find out whether the CAMEL model is still significant or not to evaluate the financial performance of the banks. To address this gap, the present study will quantitively unravel these issues through bibliometric analysis.

III. Research Objectives

- To identify the main and emerging source, author, document, and theme.
- To identify the main co-occurrence network theme.
- To gauge the degree of collaboration network of authors, institutions, and countries.
- To find out the current trend and future scope of research in the study area.
- To highlight the research gaps.

IV. Research Design/Methodology/Approach

There are many major citation databases for bibliometric analysis: Web of Science, Scopus, Google Scholar, IEEE Xplore, PubMed, Microsoft Academic Search, and SciFinder. The recent years, the combination of Scopus and Web of Science has gained more popularity due to more coverage (Ullah *et al.*, 2022) [12]. The present study relied only on the Scopus database because it is the largest citation and abstract database covering a wide range of subjects (Salleh *et al.*, 2023) [13].

The search was conducted from 2003 to 2023 using Keywords: KEY ("CAMEL" OR "CAMEL Approach" OR "CAMEL Model" OR "CAMEL Rating" OR "CAMEL Analysis" OR "CAMEL Framework" OR "CAMELS Approach" OR "CAMELS Framework") AND ("Performance Analysis" OR "Financial Performance Analysis" OR "Performance Evaluation" OR "Financial Performance") AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "FINA") OR LIMIT-TO (SUBJAREA, "SOCI").

The search resulted in 139 documents. Moher *et al.* (2009) [14] provided the guidelines of the PRISMA model which is used in this study to find and choose the pertinent research publications from Scopus. The researcher suggested the four steps as depicted in Fig. 1. 114 documents were selected for the study.

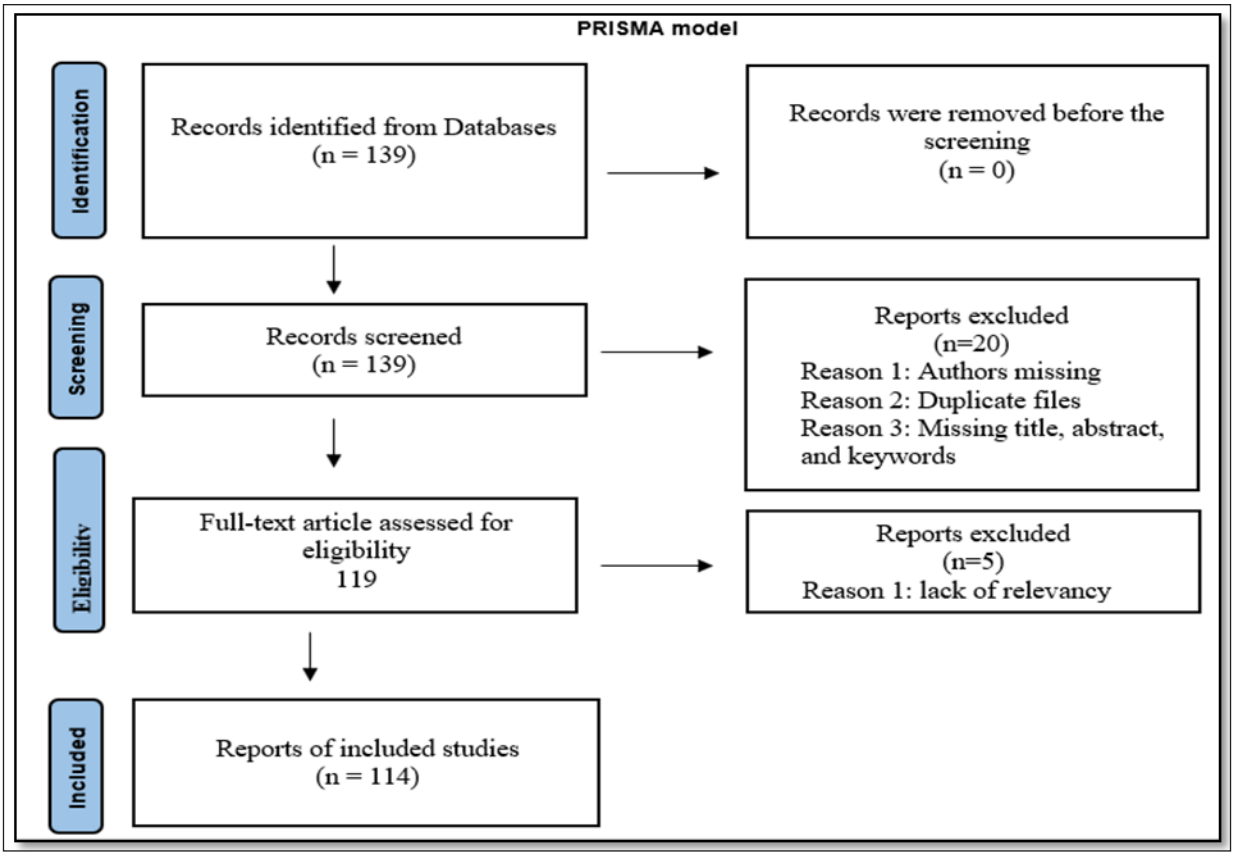


Fig. 1: PRISMA Model

The biblioshiny: the shiny app for bibliometrix from the R package was used to carry out the bibliometric analysis since it helps to execute a comprehensive science mapping analysis of scientific literature and shows the complete information (Aria and Cuccurullo, 2017) [15]. The syntax used in R programming to get the biblioshiny is: install.packages ("bibliometrix"), library (bibliometrix), biblioshiny ().

V. Data Analysis and Interpretation

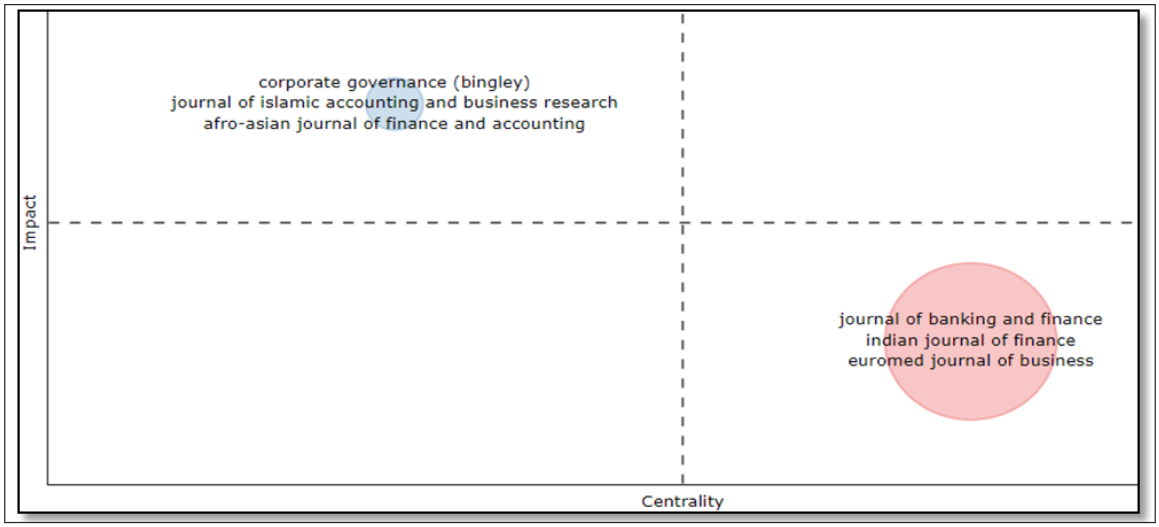
A. Clustering

i) Clustering by Coupling

The clustering displays the words in the form of colored clusters by considering the relationship between one word and another (Srisusilawati *et al.*, 2021) [16]. Fig. 2 is generated by using the following parameters: unit of analysis - source, coupling measured - Author's keywords, impact measure - global citation score, cluster labeling - author's keyword.

The result shows two clusters. 1st cluster (Blue) is in the top left quadrant which depicts three sources: Corporate Governance (Bingley), Journal of Islamic Accounting and Business Research, Afro-Asian Journal of Finance and Accounting, and Journal Pengurusan. These source journals are very impactful and have a higher number of citations but it is of less importance. Journal of Banking and Finance, Indian Journal of Finance, and Euromed Journal of Business are three sources that make up the 2nd cluster (right bottom corner). It signifies that these sources are very useful or important in this field of research but they garnered fewer citations (impact).

The cluster red is larger than the blue cluster because there are 14 sources who are working in a similar area of study while the blue cluster has only 4 sources. Among the sources, the Journal of Banking and Finance got the highest citation with 38 citations followed by Euromed Journal of Business and Indian Journal of Finance with 10.5 and 9.2 citations respectively. These three source journals are the most powerful and used sources in this field of study.



Source: Graph processed by the author using biblioshiny.

Fig. 2: Cluster by Source Coupling

B. Conceptual Structure

The conceptual structure shows the interaction between themes, topics, and trends using a co-occurrence network or co-word analysis. It is the only method that uses the content of research papers (Ingale and Paluri, 2022) [17]. The analysis of conceptual structure helps to understand the connection between various concepts in the existing literature that leads toward identifying future research agenda (Akter *et al.*, 2021) [18].

i) Co-Occurrence Network

The co-occurrence map is the most frequently used to reveal the link between the terms and visualize the main clusters (Fatehi *et al.*, 2020) [19]. The more keywords were used at the same time by authors, the greater their proximity, resulting in closer and more robust links (Forliano *et al.*, 2021) [20]. "Author keywords" were used to extract the co-occurrence network.

The result in Fig. 3 shows 5 different colors showing 5 clusters. Cluster 2 (blue) represents words like CAMELS, performance, bank performance, banks, banking sector, Islamic banking, banks, and commercial banks showing themes focusing on CAMELS and financial performance of banks. Cluster 4 (purple) represents words like capital adequacy, asset quality, liquidity, return on equity, capital, management, management capability, and management efficiency showing themes focusing on capital adequacy, asset quality, and liquidity which also has

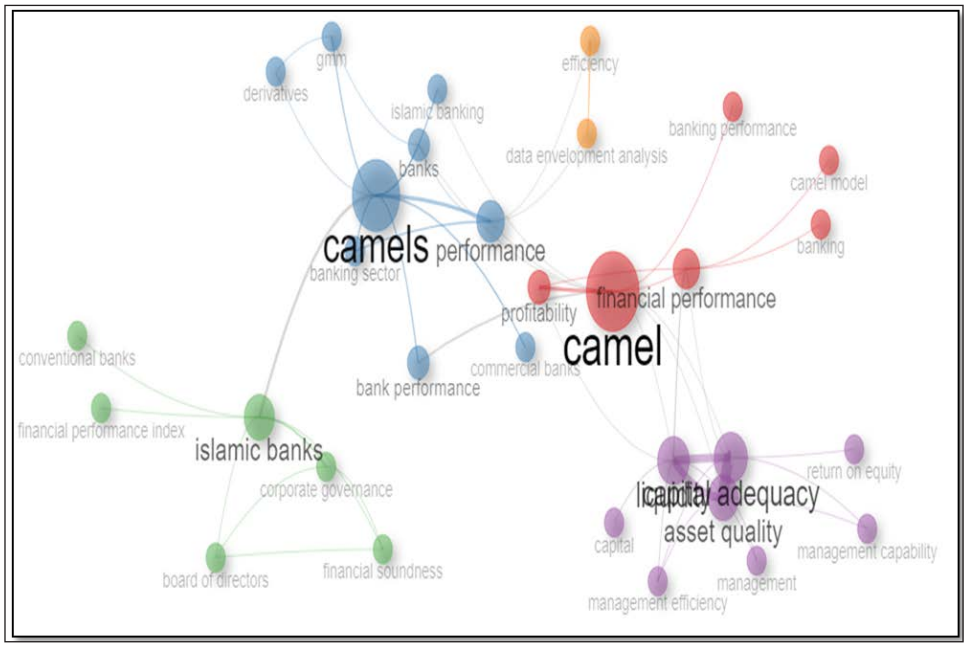


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Fig. 3: Co-Occurrence Network

the highest co-occurrence network. Cluster 3 (green) represents words like Islamic banks, corporate governance, financial soundness, board of directors, conventional banks, and financial performance index showing themes focusing on Islamic banks. Cluster 5 (yellow) is the smallest cluster representing only two words: efficiency and data envelopment analysis and also has the least co-occurrence network. The authors' keywords such as CAMEL, CAMELS, liquidity, and capital adequacy are the most used words by the author in this field of study.

However, the largest cluster (blue cluster) is formed by words like CAMELS, performance, bank performance, banks, banking sector, Islamic banking, banks, and commercial banks showing themes focusing on CAMELS, and the financial performance of banks. Thus, many documents and authors are focusing on the following keywords.

ii) Thematic Map

A thematic map is a two-dimensional diagram where themes are plotted based on their centrality and density rank values. The upper right quadrant (Q1) represents driving themes, the lower right quadrant (Q4) is underlying themes, the upper left quadrant (Q2) is the very specialized themes, and the lower left quadrant (Q3) is emerging or disappearing themes (Khongwir and Sharmiladevi, 2023) [21]. The density indicates the degree of development of the themes and centrality indicates the relevance of the themes (Wilczewski and Alon, 2023) [22]. Fig. 4 represents a thematic map using authors' keywords.

There are three clusters in the upper right corner (Motor themes) and they are Cluster 1: capital adequacy, asset quality, and liquidity having strong centrality and density, Cluster 2: CAMEL, CAMELS, and Islamic Banks, and Cluster 3: non-performing loans and commercial bank. These following themes are the leading themes within the field and they are well-developed and important themes for the structuring of a research field.

Themes such as banking, CAMEL, and Data envelopment analysis are shown in Q4 which are basics and very important for the field's development. These themes are important to be included in the research as they are general topics that are commonly used. Themes in Q2 such as the CAMELS approach, and financial stability, are very specific and rare theme but has high development, indicated by high density but low centrality. Themes like management quality, bank performance, and CAMEL approach found in Q3 are emerging or declining theme with low centrality and density and is weakly developed.

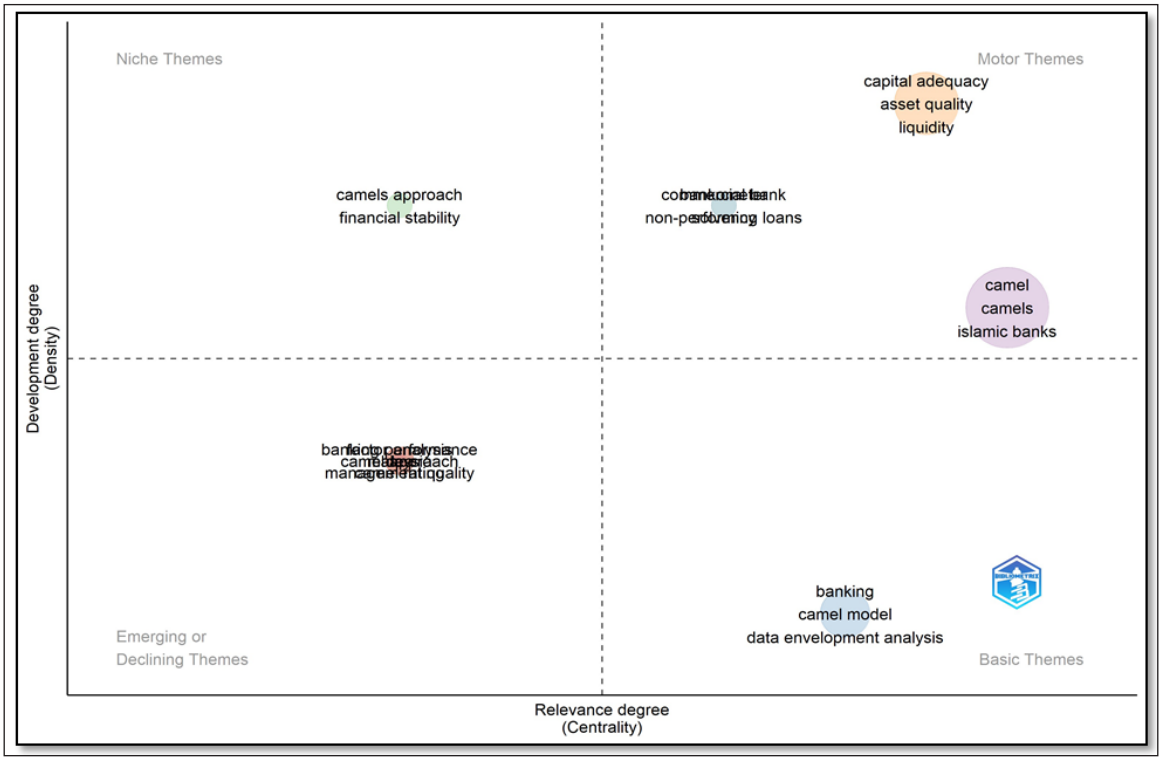

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Fig. 4: Thematic Map

iii) Thematic Evolution

Thematic evolution uses performance analysis and scientific mapping to identify themes and sub-themes of a particular research field for a specific period by dividing the time frame into different periods (Chen *et al.*, 2019) [23]. Fig. 5-7 used the author's keywords to generate a thematic map and evolution from 2003 to 2023 with one cutting point of 2018 was used, dividing the time frame into two slices namely slice 1 ranging from 2003 to 2018, slice 2 covering from 2019 to 2023.

Fig. 6 depicts the thematic development of Time Slice 1 from 2003 to 2018, the themes such as financial performance, CAMEL, Islamic banks, and banking industry are in the motor theme. This indicates that the themes are well-developed and crucial because they are the dominant themes in the industry. Additionally, a lot of writers are exploring these issues. Themes such as banks, privatization, and rivals' reactions are Niche themes indicating well-developed themes but not so relevant to the authors. The themes CAMEL, Bank Performance, and Profitability are very relevant but the themes are not well developed. This is a good area for scholars to explore as it is developed well. Most importantly the emerging or declining themes for scholars to study are factor analysis and Islamic banking.

Fig. 7 represents the thematic evolution of time slice 2 from 2019-2023, where it displays that over the five years, the relevance and development of themes have total into a new direction that themes such as Islamic banks, corporate governance, financial soundness, liquidity, capital adequacy, and asset quality has replaced older themes in motor theme quadrant. This means now author's field of interest has changed. These new themes are well-developed and important for researchers to study and it is the direction that every researcher is focusing on. Likewise, themes such as "non-performing Loans" and "return on equity" are new in basic themes except "CAMEL". These themes are very relevant but not well-developed or researched. It is an opportunity for scholars and researchers to study this theme as it provides more insight. Similarly, the niche themes are now "CAMEL approach" and "Financial stability" which are well-developed concepts but not so relevant as it is specialized. Now emerging themes in this field of study are "banking", "management quality" and "banking performance" which is going to be an important topic to be researched or studied.

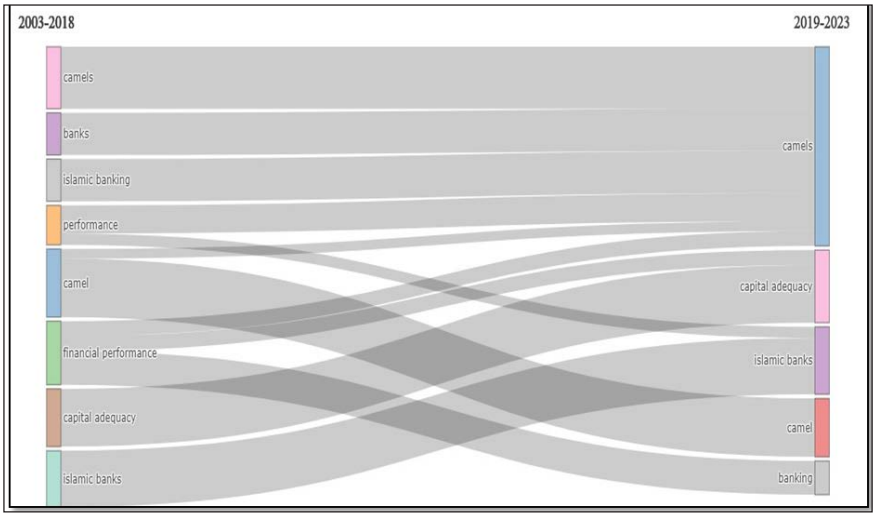

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Fig. 5: Thematic Evolution

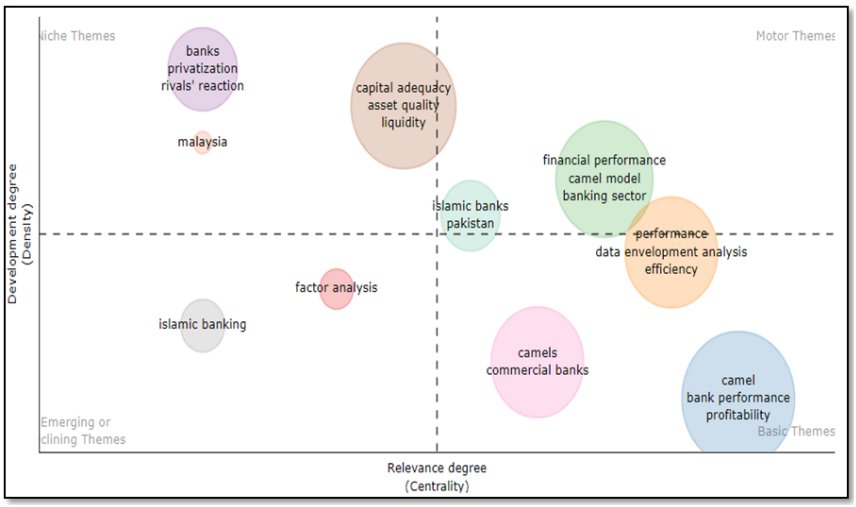

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Fig. 6: Time Slice 1 - Thematic Evolution (2003-2018)

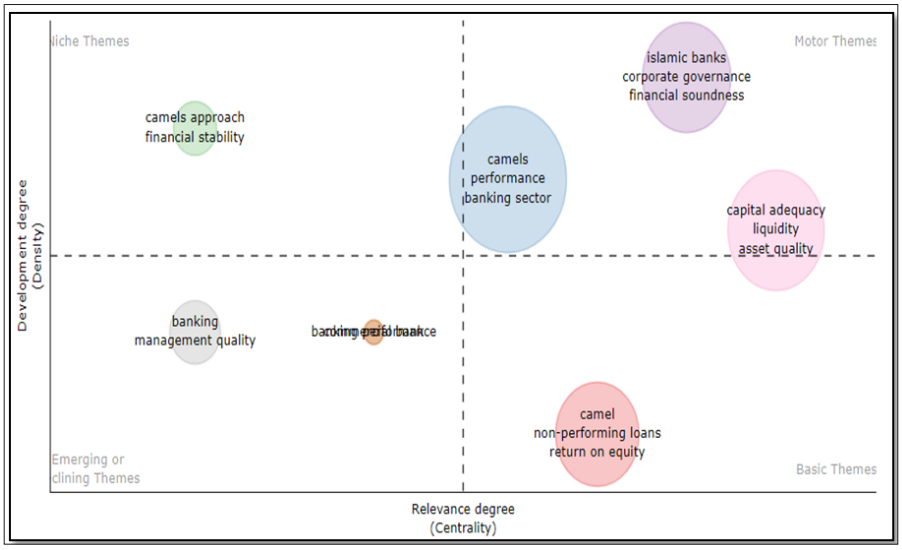

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Fig. 7: Time Slice 2 - Thematic Evolution (2019-2023)

iv) Factorial Analysis

The factorial analysis tool in Biblioshiny is used with the auto-generation option to identify different clusters and their conceptual structure. It recognizes the contextual structure of screened extant literature, and a factorial analysis is conducted using multiple correspondence analysis (MCA) (Sahoo, 2022) [24]. Fig. 8 is generated using the MCA method and keeping the Author's keywords as a field and the number of clusters is 2.

The factorial analysis identifies two dominating macro clusters in the chosen research subject. The 1st cluster (red) is the most significant consists of 54 keywords that focus on the CAMELS, CAMEL, financial performance, credit risk and etc. These keywords used by the authors are closely related to each other and they are gaining more attention in recent years. Among them, bank performance, banking, credit risk, financial performance, and CAMEL is the most in-depth. The 2nd Cluster (blue) comprises of board of directors and financial soundness which are less significant and got less attention in recent years. Moreover, these words are less frequently discussed but still, they provide room for exploration.

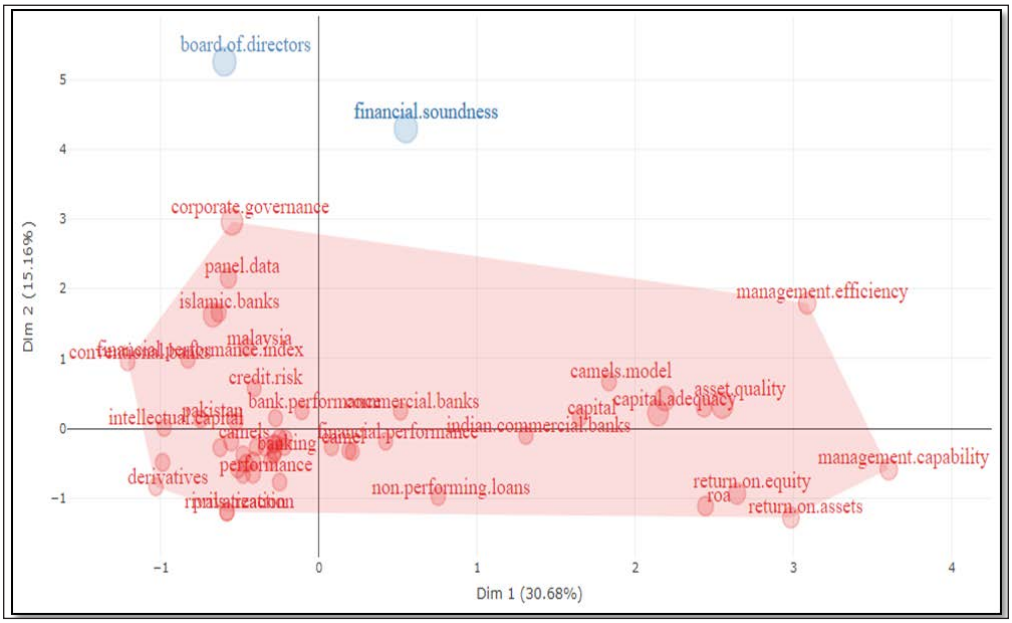

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Fig. 8: Factorial Analysis

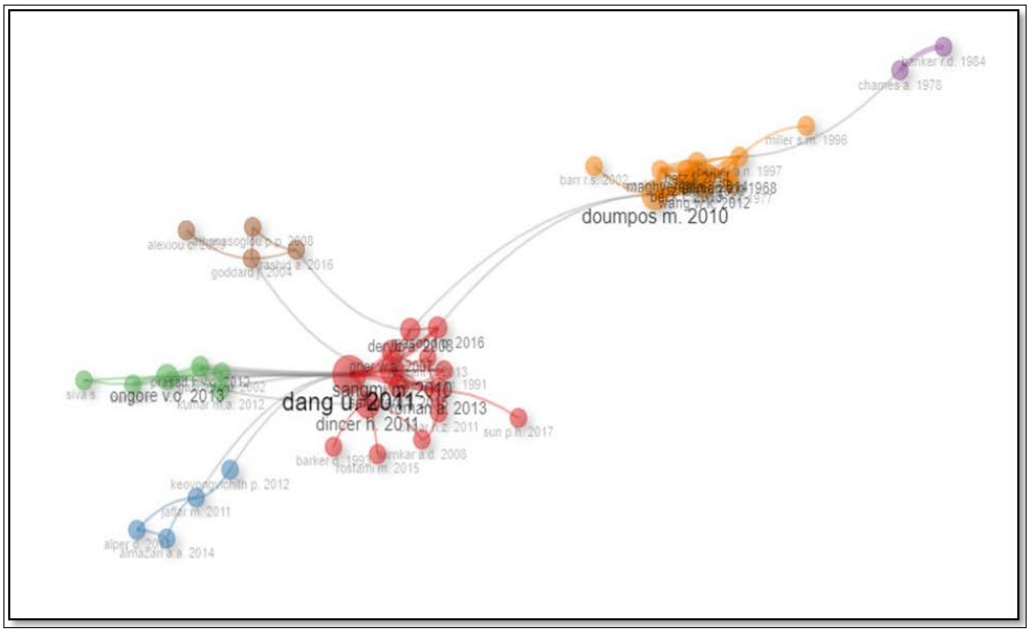
C. Intellectual Structure

The intellectual structure displays the interaction among themes, authors, and topics using a co-citation network or authors' analysis (Sivankalai and Sivasekaran, 2021) [25].

i) Co-Citation Network Analysis

Co-citation analysis involves tracking pairs of papers that are cited together in the source articles. Co-citation analysis (ACA) has long been used to identify a research domain's intellectual structure (Jeong *et al.*, 2014) [26]. When the same pairs of papers are co-cited by many authors to identify a research domain's intellectual structure, clusters of research begin to form. The co-cited papers in these clusters tend to share some common themes.

Fig. 9 displays the co-citation analysis using a paper from the field and depicts top paper co-citation. There are 6 clusters with author names displayed where the red color cluster is the largest with 15 authors' papers that are similar to each other since they are co-cited. Then it is followed by a yellow-colored cluster and a green colored cluster. The purple-colored cluster is the smallest with only two authors whose papers are correlated or similar in nature since they are co-cited together. The greater the degree of co-citation, the bigger the author names (nodes) are. In this instance, M. Doumpos (2010), A. Derviz (2008) and U. Dang (2011) are in order of highest betweenness centrality (428.22, 404.23, and 252.67, respectively). The papers of these three authors have the highest number of co-citations indicating that it has significantly advanced the CAMEL technique for the banking industries. Moreover, these papers are the most influential and significant in this field of study.



Source: Graph processed by the author using biblioshiny.

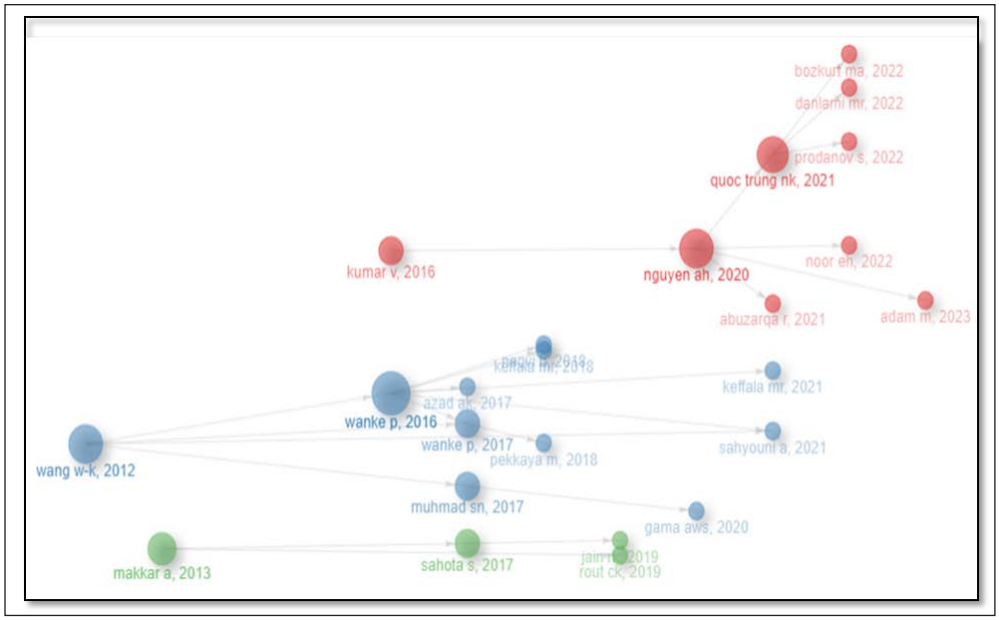
Fig. 9: Co-Citation Network Analysis

ii) Historiograph

Eck and Waltman (2014) [27] added that histography shows the most important publications in a field, ordered by the year in which they appeared, and the citation relations between these publications, one obtains a picture of the development of a field over time. In Fig. 10 the circle is a node that shows the number of citations an author received where the bigger the circle, the higher the citation, and vice versa. The line joining the circle implies the citation network or relationship.

The result showed that there are 3 clusters. The largest cluster is cluster 1 (blue) which consists of 11 publications that were started from the paper: Does corporate governance play an important role in the performance? Evidence from the U.S. authored by W.-K. Wang, 2012 which is then further developed by P. Wanke, 2016. Then from 2017, this cluster included several more recent empirical studies. 2nd largest cluster is cluster 3 (red) which originated from V. Kumar, 2016, who published an article: evaluating the financial performance and financial stability of national commercial banks in the UAE. Then it was advanced further by A. H. Nguyen in 2020, and many more authors. Now the emerging theme from this root theme is measuring enterprise risk management implementation: a multifaceted approach for the banking sector by M. Adam, 2023. The smallest cluster is cluster 3 which was initiated firstly by A. Makkar in 2013 and was further developed by S. Sahota, 2017; C. K. Rout, 2019, and R. K. Jain, 2019 respectively.

Lastly, there are three core authors: V. Kumar, W.-K. Wang, and A. Makkar who initiated the study and formed a cluster. More so, their articles are the highest cited and most influential papers. Moreover, the number of publications had increased a lot for past few years indicating the CAMEL model still hold significance to measure the financial soundness of the banks.



Source: Graph processed by the author using biblioshiny.

Fig. 10: Historiograph

D. Social Structure

Forliano *et al.* (2021) [20] state that the social structure highlights the connections that occur between different units of analysis, such as authors, institutions, and countries.

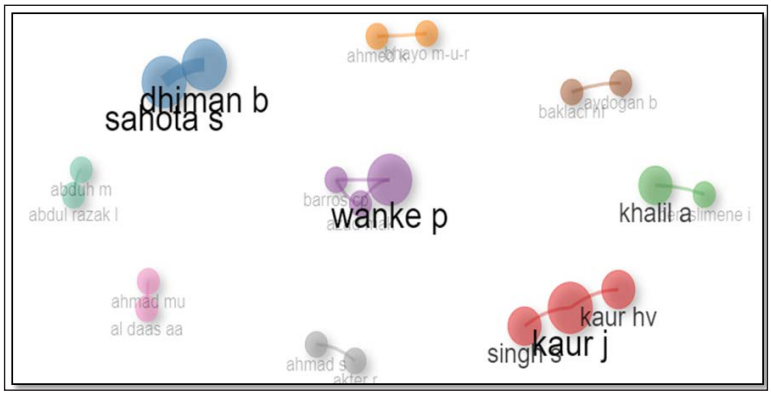
i) Collaboration Network

The collaboration network shows the relationship between the countries, institutions, and authors. Each circle represents the country, institution, and author, and the line connecting the circles shows a relationship or collaboration. A strong relationship is represented by a combination of many circles (clusters). Each cluster is represented by a color. The size of the node represents the productivity. The shorter the distance between two nodes, the more closely connected they are.

Fig. 11 shows the collaboration of 20 authors which resulted in 9 clusters. The two clusters with the most author collaborations are cluster 4 (purple) in the center, with three authors working together (P. Wanke, Azad Mak, and C. P. Barros), and similarly with cluster 1 (red) (H. V. Kaur, J. Kaur, and S. Sing). Whereas the remaining clusters have two authors collaborate.

23 countries' collaboration network is depicted in Fig. 12 with 7 clusters. Cluster 1 was formed by China, Pakistan, United Kingdom, United Arab Emirates, Nigeria, and Norway the highest number of countries collaborating followed by Cluster 2 (Malaysia, Brazil, USA, Saudi Arabia, Portugal) and Cluster 3 (India, Jordan, Bahrain, Oman). While the remaining clusters have an equal number of 2 countries collaborating.

The circle represents institutions and the line joining the circle shows collaboration in Fig. 13. The result shows only one cluster that represents two institutions namely the Federal University of Rio De Janeiro and the University of Malaya who were collaborating in this particular field of study.



Source: Graph processed by the author using biblioshiny.

Fig. 11: Collaboration Network (Authors)

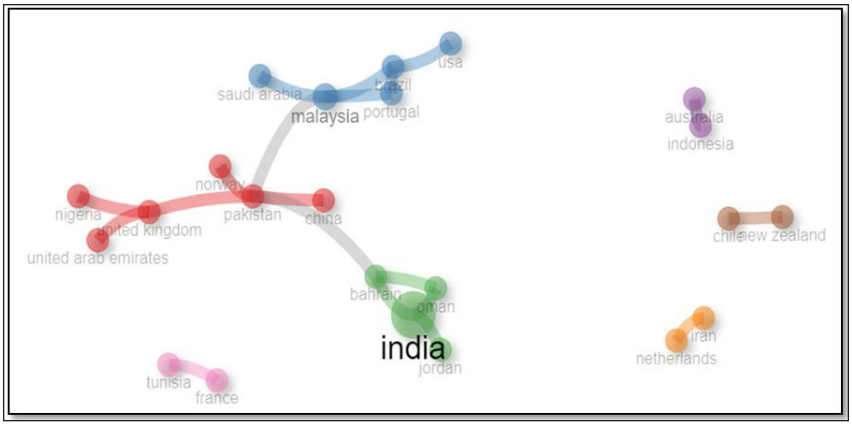


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Fig. 12: Collaboration Network (Countries)

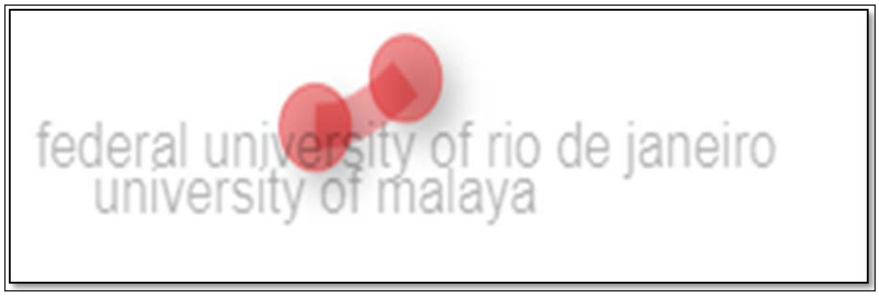

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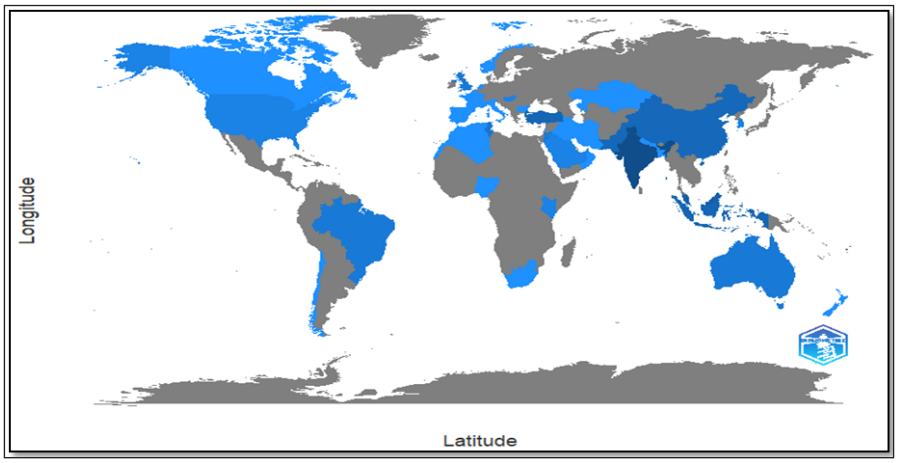
Fig. 13: Collaboration Network (Institution)

ii) Countries Collaboration World Map

Fig. 14 shows the primary contributing countries and regions in the knowledge domain. The color intensity is proportional to the number of publications and signifies the number of articles per country (Nidhi and Anand, 2022) [28]. All these blue color shows the countries that collaborated with other countries in this particular field of study and the darker color blue signifies a higher level of collaboration.

The darkest one is Malaysia (4 collaborations) because it has the highest collaboration with other countries followed by India and Pakistan with 3 collaborations each. Especially African continent countries are having the lowest collaboration. Overall good number of countries is working in this field of study but collaboration is still in infants which means more countries need to collaborate.



Source: Graph processed by the author using biblioshiny.

Fig. 14: Countries Collaboration World Map

VI. Conclusion and Discussion

The study revealed that the Journal of Banking and Finance was the most prominent and influential source journal with the highest citations followed by Euromed Journal of Business and the Indian Journal of Finance. These three journals were in the same cluster and shared similar work. The most extensively studied, cited, and emerging as dominating themes were CAMEL, CAMELS, liquidity, and capital adequacy. While, the emerging or declining themes were management quality, bank performance, and the CAMEL approach which will be either a stream of study in the future or just an insignificant theme. The dominance and significance of the theme evolved where before 2003 the dominant themes were financial performance, CAMEL, Islamic banks, and the banking industry which were shifted to new themes such as Islamic banks, corporate governance, financial soundness, liquidity, performance, banking sector, capital adequacy, and asset quality except CAMEL. These new themes were dominating the research and many studies were focusing on it.

The documents produced by M. Doumpos (2010), A. Derviz (2008) and U. Dang (2011) were the most relevant and significant papers in this field of study. Whereas authors: V. Kumar, W.-K. Wang, and A. Makkar initially initiated the study and formed a cluster. 3 authors collaboration was the highest collaboration with only two clusters while the remaining cluster had only two authors. It showed minimal collaboration and directed the need for robust collaboration in the future. In terms of institutions only one cluster that represents two institutions namely the Federal University of Rio De Janeiro and the University of Malaya which were collaborating. It showed that universities and institutions were not collaborating much when it comes to this field of study.

23 countries had contributed to this study. The highest collaboration was formed by China, Pakistan, the United Kingdom, the United Arab Emirates, Nigeria, and Norway. Country-wise Malaysia (4 collaborations) had the highest collaboration with other countries followed by India and Pakistan with 3 collaborations each. Especially African continent countries were having the lowest collaboration. Overall good number of countries were working in this field of study but collaboration is still in infants which means more countries need to collaborate.

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