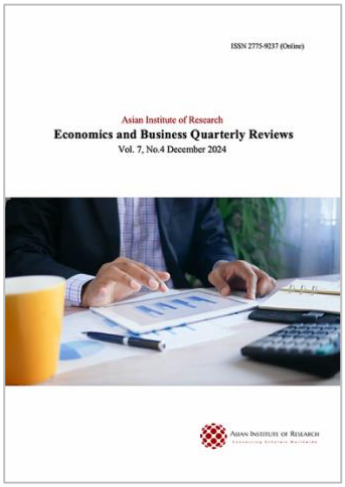

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Literature Review of Measuring Operational Efficiency of Commercial Banks using DEA Model

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Abstract
This paper examines the operational efficiency of commercial banks through the lens of the Data Envelopment Analysis (DEA) model, highlighting its significance in assessing banking performance in a rapidly evolving financial landscape. By analyzing key literature and trends, the study identifies critical factors influencing bank efficiency, including technological advancements, sustainability, and regulatory frameworks. It also explores the impact of digital transformation on traditional banking operations and emphasizes the importance of customer-centric approaches in enhancing service efficiency. Furthermore, the paper discusses future research directions, such as the integration of artificial intelligence and big data analytics, cross-country comparisons, and the relationship between operational efficiency and risk management. Ultimately, this study aims to provide insights for scholars and practitioners seeking to enhance the competitiveness and resilience of commercial banks in an increasingly complex global environment.

Keywords: DEA Model, Commercial Bank, Operational Efficiency, Bibliometrics

1. Introduction

Several key researchers have made significant contributions to the study of operational efficiency in commercial banks using the DEA model. Charnes, Cooper, and Rhodes (1978) were pioneers, developing the original DEA model (CCR) to evaluate the efficiency of decision-making units (DMUs) based on inputs and outputs, laying the foundation for subsequent research (Charnes et al., 1978). Banker, Charnes, and Cooper (1984) expanded on the CCR model, developing the BCC model, which accounts for variable returns to scale, allowing for efficiency assessments when banks operate at different scales (Banker et al., 1984). Berger and Humphrey (1997) made a substantial contribution by reviewing various methods for measuring banking efficiency, including DEA, offering a comprehensive overview and setting directions for future research (Berger & Humphrey, 1997).

Färe, Grosskopf, and Lovell (1985) introduced the concepts of cost efficiency and allocative efficiency, extending the application of DEA in economic studies (Färe et al., 1985). Seiford and Zhu (1999) applied DEA to measure the efficiency of the top 55 U.S. commercial banks, providing a detailed analysis of profitability and marketability, offering valuable insights into bank performance (Seiford & Zhu, 1999). Lastly, Asmild, Paradi, Aggarwal, and Schaffnit (2004) combined DEA with the Malmquist index approach to study the efficiency of Canadian banks, comparing the results with other methods such as Stochastic Frontier Analysis (SFA), which improved the precision of efficiency measurements (Asmild et al., 2004). These contributions have helped shape the

understanding and methodology of measuring bank efficiency using DEA, providing solid theoretical and empirical frameworks for ongoing research in this field.

With a literature review, this study answers the question: *What is the current publication trend of research on measuring the operational efficiency of commercial banks using DEA model?*

2. Data Source and Methodology

The study's objective was to provide academics and industry practitioners with an in-depth understanding of the structure (clusters), research areas, and trending topics through the use of illustrative diagrams and maps through a systematic review, analyses, and visualization. Web of Science (WoS) database was the only source for the study's data collection. WoS is the most critical database for scientific research and the top scientific citation search and analytical information platform globally (Li, Rollins, & Yan, 2018). The author collected data from 2015 to 2024 on WoS, the period when this topic was most focused on research. The number of documents is 1000 documents.

Bibliometrics is a quantitative method used to analyze academic literature, providing insights into research trends, the impact of scholarly publications, and collaboration patterns. This approach primarily involves the statistical analysis of publications, citations, and authorship to evaluate research performance. Citation analysis, one of the key bibliometric techniques, measures the influence of a publication or author by counting the number of citations received, thus assessing their impact on subsequent research (Garfield, 2006). Other techniques include bibliographic coupling, which links two papers based on shared references, and co-citation analysis, which identifies intellectual connections between papers frequently cited together (Small, 1973). Co-authorship analysis is another vital aspect, as it helps visualize collaboration networks between researchers or institutions, highlighting trends in scientific partnerships (Glänzel & Schubert, 2005). Tools such as Web of Science, Scopus, and software VOSviewer and CiteSpace are commonly used to perform these analyses (van Eck & Waltman, 2010). Bibliometric methods are widely applied to measure research productivity, identify emerging research fields, and map the development of scientific disciplines. However, it is important to recognize the limitations of bibliometrics, such as the uneven coverage of certain fields or journals in citation databases, and the fact that high citation counts do not always reflect the quality or significance of a study (Moed, 2005). Overall, bibliometrics offers a robust framework for understanding the structure and dynamics of academic research, enabling informed decision-making in research policy and management.

3. Bibliometric Analysis, Results, and Discussion

3.1. Most Influential Source Title

The below table presents the top 15 academic sources ranked by the number of documents related to measuring the operational efficiency of commercial banks using the DEA (Data Envelopment Analysis) model. The "Journal of Asian Finance Economics and Business" and the "Journal of Banking Finance" lead the list, each publishing 47 documents on the topic. However, despite publishing the same number of documents, the h-index of the "Journal of Banking Finance" (78) is significantly higher than that of the "Journal of Asian Finance Economics and Business" (10), indicating that the former's publications are more frequently cited and have greater academic impact. Other key contributors include "Sustainability" (30 documents), "Cogent Business Management" (27 documents), and "Cogent Economics Finance" (26 documents), highlighting these journals as important sources for research on DEA in banking.

Regarding publishers, Elsevier stands out as the most prominent, supporting high-impact journals such as the "Journal of Banking Finance," "Pacific Basin Finance Journal," and "Expert Systems with Applications," the latter boasting an exceptional h-index of 148. This indicates that despite publishing fewer documents (10), "Expert Systems with Applications" has a significant influence on the field, as its papers are highly cited. Taylor & Francis and MDPI also have notable contributions, with journals like "Cogent Business Management," "Cogent Economics Finance," and "Sustainability" adding substantial numbers of documents. Journals like "Applied

Economics" (h-index of 67) and "Journal of Risk and Financial Management" (h-index of 20) further emphasize the diversity of sources contributing to DEA research in the banking sector, illustrating the wide-ranging academic impact of these publications**.**

Table 1: Top 15 sources ranked according to measure operational efficiency of commercial banks using DEA model

Source Title	Documents	Publisher	h-Index
JOURNAL OF ASIAN FINANCE ECONOMICS AND BUSINESS	47	Annual	10
JOURNAL OF BANKING FINANCE	47	Elsevier	78
SUSTAINABILITY	30	MDPI	40
COGENT BUSINESS MANAGEMENT	27	Taylor & Francis	15
COGENT ECONOMICS FINANCE	26	Taylor & Francis	20
BANKS AND BANK SYSTEMS	23	Virtus Interpress	9
APPLIED ECONOMICS	20	Taylor & Francis	67
JOURNAL OF RISK AND FINANCIAL MANAGEMENT	16	MDPI	20
PACIFIC BASIN FINANCE JOURNAL	16	Elsevier	32
RESEARCH IN INTERNATIONAL BUSINESS AND FINANCE	12	Elsevier	25
EMERGING MARKETS FINANCE AND TRADE	10	Taylor & Francis	39
EXPERT SYSTEMS WITH APPLICATIONS	10	Elsevier	148
FINANCE RESEARCH LETTERS	10	Elsevier	23
INTERNATIONAL REVIEW OF FINANCIAL ANALYSIS	10	Elsevier	34
NORTH AMERICAN JOURNAL OF ECONOMICS AND FINANCE	10	Elsevier	27

Source: Author's analysis of the WOS database

3.2. Most active regions in research field

The table provides a detailed analysis of the publication output and citation metrics of various countries in the field of research related to operational efficiency in commercial banks using the DEA (Data Envelopment Analysis) model. China leads with the highest number of publications (222 articles) and a total of 4,868 citations, resulting in a citations per article (TC/Art) rate of 21.93. While China has a significant quantity of research output, its citation impact is comparatively lower than that of the USA, which, despite publishing fewer articles (132), has garnered an impressive 7,096 citations and a much higher TC/Art rate of 53.76. This indicates that American research in this area is not only more prolific but also has a greater academic impact per publication. England follows closely with 69 articles and 3,263 citations, achieving a TC/Art of 47.29, reflecting its strong presence in the field. Other notable contributors include Taiwan and Australia, with 52 and 39 articles, respectively, and varying citation impacts. Interestingly, Vietnam stands out with 109 publications, though its citation rate is notably lower at 6.90 TC/Art, suggesting that while the country is actively contributing to the research output, the impact of its work may not be as pronounced as that of other nations. Countries like Pakistan, Malaysia, Indonesia, and India show a lower quantity of publications and citations, with India achieving a TC/Art of 9.07 from 59 articles, indicating a potential area for growth in research productivity and influence. Overall, the data underscores significant disparities in both the volume and impact of research across countries, highlighting the USA's dominance in producing highly cited works in this important area of study.

Country	Quantity	Cites	TC/Art
China	222	4868	21,93
USA	132	7096	53,76
England	69	3263	47,29
Taiwan	52	1026	19,73
Australia	39	744	19,08
Pakistan	47	593	12,62
Vietnam	109	752	6,90
Malaysia	38	415	10,92
Indonesia	36	181	5,03
India	59	535	9,07

Table 2: Top 10 ranking of countries by article, citations, and h-indeks

Source: Author's analysis of the WOS database

3.3. Publications with the highest impact

The table presents a list of the top 10 most cited articles related to operational efficiency in commercial banks, highlighting the significant contributions of these works to the academic discourse in the field. The most cited article, authored by Seiford and Zhu, titled "Profitability and marketability of the top 55 US commercial banks," has amassed an impressive 709 citations. This indicates that their research is widely acknowledged and utilized by scholars and practitioners alike, reflecting its foundational importance in understanding the profitability dynamics of U.S. banks.

Demirgüç-Kunt and Huizinga's article on the "Determinants of commercial bank interest margins and profitability" has received 690 citations, emphasizing its role in providing international evidence on key factors influencing bank profitability. This suggests a strong interest in comparative studies that examine the nuances of banking profitability across different economic contexts. The third article, by Berger, Hasan, and Zhou, investigates bank ownership and efficiency in China and has garnered 557 citations. This underscores the relevance of ownership structures in understanding bank performance, particularly in the context of a rapidly evolving banking landscape in one of the world's largest economies. The table also includes significant contributions from authors such as de Andres and Vallelado, whose work on corporate governance in banking has been cited 521 times, and Dietrich and Wanzenried, who explored the determinants of bank profitability during economic crises, receiving 387 citations. These articles highlight the importance of governance and external economic factors in shaping bank performance. Moreover, the presence of studies focused on specific regions, such as Bhattacharyya et al. discussing the impact of liberalization on Indian banks (321 citations) and Lin and Zhang on bank ownership reform in China (280 citations), illustrates the global breadth of research in this area. The cited works indicate a strong emphasis on understanding both the micro (bank-specific) and macro (economic and regulatory) factors influencing bank efficiency and profitability, demonstrating the multifaceted nature of research in this domain. Overall, the high citation counts reflect the articles' impact and their essential role in advancing knowledge on operational efficiency within the banking sector.

Author	Title	Total Citation
Seiford, LM; Zhu, J	Profitability and marketability of the top 55 US commercial banks	709
Demirgüç-Kunt, A; Huizinga, H	Determinants of commercial bank interest margins and profitability:: Some international evidence	690
Berger, Allen N.; Hasan, Iftekhar; Zhou, Mingming	Bank ownership and efficiency in China: What will happen in the world's largest nation?	557
de Andres, Pablo; Vallelado, Eleuterio	Corporate governance in banking: The role of the board of directors	521
Dietrich, Andreas; Wanzenried, Gabrielle	Determinants of bank profitability before and during the crisis: Evidence from Switzerland	387
Garcia-Herrero, Alicia; Gavila, Sergio; Santabarbara, Daniel	What explains the low profitability of Chinese banks?	325
Bhattacharyya, A; Lovell, CAK; Sahay, P	The impact of liberalization on the productive efficiency of Indian commercial banks	321
Lin, Xiaochi; Zhang, Yi	Bank ownership reform and bank performance in China	280
Berkowitz, J; O'Brien, J	How accurate are value-at-risk models at commercial banks?	269
Wang, Ke; Huang, Wei; Wu, Jie; Liu, Ying-Nan	Efficiency measures of the Chinese commercial banking system using an additive two-stage DEA	268

Table 3: Top 10 most cited articles

Source: Author's analysis of the WOS database

3.4. Co-word analysis

The VOSviewer image presents a compelling visualization of key concepts in the field of operational efficiency in commercial banks, particularly emphasizing the Data Envelopment Analysis (DEA) model. The nodes, representing various keywords, showcase a rich tapestry of themes central to banking research. Notably, the prominent clusters—highlighted in distinct colors—indicate the importance of concepts such as "performance," "ownership," and "determinants." The size of these nodes reflects their frequency in the literature, suggesting that these areas are heavily researched and integral to understanding banking operations. The interconnectedness of these nodes, illustrated by the lines connecting them, reveals the relationships and interactions among different concepts. Thicker lines signify stronger connections, indicating that topics like "competition" and "market power" are frequently discussed in tandem with "bank performance." This underscores the multifaceted nature of banking efficiency, where numerous factors interplay to influence outcomes. The inclusion of geographical references, such as "India," "Vietnam," and "Bangladesh," highlights the regional dimensions of the research, suggesting a focus on how local contexts shape banking practices and performance. Furthermore, the presence of methodological terms like "data envelopment analysis" and "panel-data" points to a robust analytical framework utilized in the research. This reflects a growing reliance on quantitative methods to derive insights from banking data, reinforcing the significance of empirical analysis in understanding efficiency. Overall, the visualization encapsulates the complexity of operational efficiency in commercial banks, revealing a dynamic and interconnected research landscape that invites further exploration and collaboration among scholars.

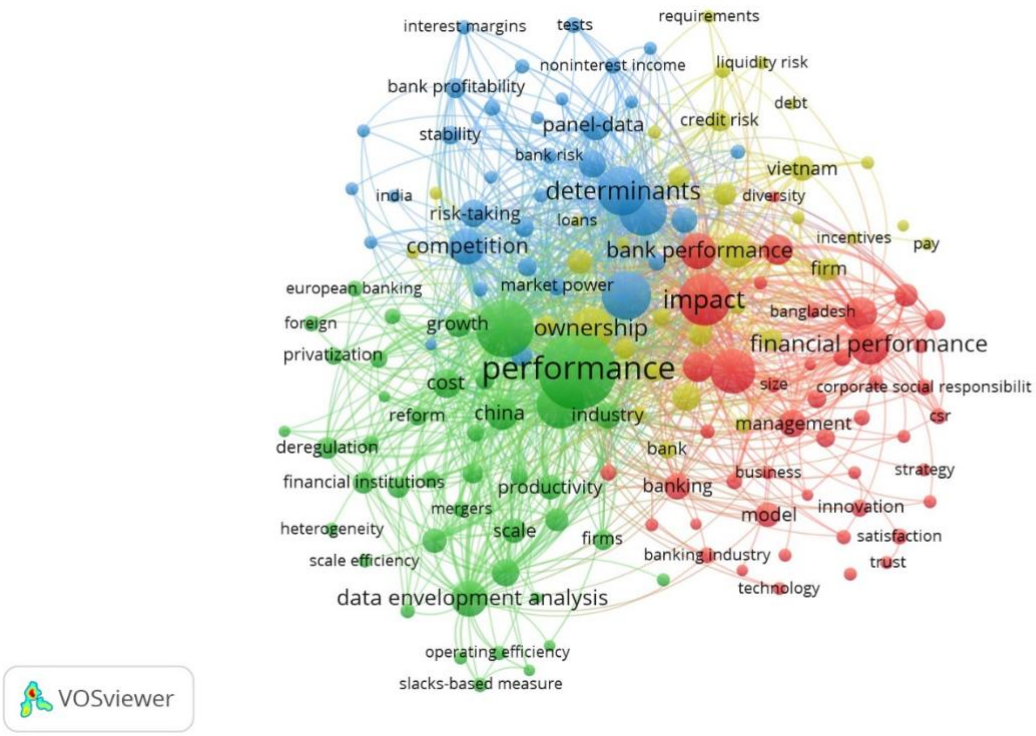

Figure 1: Overlay visualization map for co-occurring keywords

Source: Author's analysis of the WOS database

4. Conclusion & Future research direction

The future trends in the research of operational efficiency in commercial banks, particularly through the lens of the Data Envelopment Analysis (DEA) model, are poised to evolve in several significant directions. One key area is the integration of advanced technologies, such as artificial intelligence (AI) and machine learning, into DEA frameworks, enhancing the analysis by accounting for a broader range of variables and dynamic market conditions. Additionally, there is a growing emphasis on sustainability and environmental, social, and governance (ESG) factors, which will likely lead researchers to adapt DEA models to incorporate these important metrics, aligning with the global push for responsible banking practices. Moreover, cross-country comparisons will become increasingly relevant, allowing for an exploration of how different regulatory environments, economic conditions, and cultural factors influence banking efficiency. This trend is particularly important in the context of globalization. As the financial landscape continues to evolve, a heightened interest in the relationship between operational efficiency and risk management is expected, especially concerning how banks can optimize their performance while managing various risks in volatile environments. The impact of digital transformation, accelerated by the COVID-19 pandemic, will also be a critical area of focus, with researchers investigating how initiatives such as online banking and fintech collaborations affect traditional banks' efficiency. Furthermore, a shift towards customer-centric models may emerge, examining how customer satisfaction and engagement influence bank performance through enhanced service efficiency. Lastly, the utilization of big data analytics in banking is likely to gain prominence, leading to the development of more nuanced DEA models that incorporate vast amounts of data for better decision-making. In summary, the future of research on operational efficiency in commercial banks will be characterized by technological advancements, a focus on sustainability, and a comprehensive understanding of the interplay between efficiency, risk, and customer experience.

In conclusion, the study of operational efficiency in commercial banks, particularly through the Data Envelopment Analysis (DEA) model, is a dynamic and evolving field that plays a crucial role in understanding the performance and competitiveness of banking institutions. As the banking landscape becomes increasingly complex due to

technological advancements, regulatory changes, and shifting customer expectations, the importance of assessing and enhancing operational efficiency cannot be overstated. Future research is likely to explore the integration of advanced analytics and AI, the impact of sustainability and ESG factors, and the effects of digital transformation on bank performance. Additionally, cross-country comparisons and a focus on risk management will provide valuable insights into the diverse challenges and opportunities faced by banks worldwide. Ultimately, by continuously adapting research methodologies to reflect these emerging trends, scholars and practitioners can contribute to the development of more efficient, resilient, and customer-focused banking systems that effectively meet the demands of a rapidly changing financial environment.

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