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Overview of Performance Analytics in the Insurance Industry

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Abstract:

Research Question: This study explores various methodological approaches used to evaluate performance analytics in the insurance industry from 2020 to 2024, with the aim of improving efficiency. **Motivation:** Modern business operations and activities in the insurance domain face multiple challenges arising from dynamic regulatory changes, digitalization, and growing business competition. In this context, performance analytics represents a key means designed to enable the evaluation and improvement of efficiency, productivity, and decision-making processes. Although multiple scientific studies have addressed this topic, a significant lack of systematic literature analysis covering the last five years is evident. In this research, by combining bibliometric analysis and content classification, a thorough analysis of recent literature was carried out to highlight the variety of methodological approaches and compare their different applications in the insurance domain. Understanding the specific uses of performance analytics enables decision-makers to better optimize their resources, reevaluate and improve their strategies, and become more competitive in the field. **Idea:** The core idea of the study is to provide a structured overview of the scientific literature published from 2020 to 2024, mainly focusing on different methodologies used to evaluate performance, such as DEA and SFA, while also examining the input and output indicators used, as well as different efficiency measures. **Data:** The analysis covers 84 scientific papers collected from relevant databases (Web of Science, Scopus, ScienceDirect, Google Scholar) for the period 2020-2024. The data include key methods, used indicators, application areas, as well as regional and institutional distribution of the research. **Tools:** A designated Python script was written and used to extract key bibliometric data for the analyzed scientific papers. In order to visualize those data, specialized software VOSviewer was used, along with Excel, which was mainly used for statistical processing. **Findings:** Most of the papers use DEA method, its variations or combinations, with technical efficiency and productivity being the most frequently measured aspects. The most common inputs (operating costs, capital) and outputs (net profit, investment income) were identified. Chinese institutions lead in terms of both the number and impact of publications. Non-DEA studies mostly focus on corporate governance and the impact of ESG factors. The methodological diversity and the importance of performance analytics for strategic decision-making in the insurance sector are highlighted. **Contribution:** The paper provides a comprehensive review and comparison of performance analytics applications in the insurance sector over the past five years, covering methodologies, input-output indicators, areas of application, and institutional contributions.

Keywords: performance analytics, insurance industry, efficiency, Data Envelopment Analysis (DEA), productivity

JEL Classification: C67, D24, G22, M21

1. Introduction

A resilient insurance industry plays a crucial role in shaping the overall economy of a nation. By facilitating essential services that contribute to efficient risk management and achieving financial stability, insurance companies drive economic activity by promoting trade, complementing government security programs and boosting investment in critical sectors. Even though insurance companies facilitate many economy-related processes, for their actions to yield positive results, they primarily depend on their solvency, productivity and efficiency. Therefore, given that the business industry is confronted with dynamic changes and an increasingly competitive environment, it is essential to track, record, improve and predict significant changes driven by regulatory shifts, technological innovations and overall economic uncertainty. An approach that takes into account all significant indicators and eases the monitoring of overall performance in the growing

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insurance industry is the application of performance analytics (Vintila, Trucmel & Roman, 2022). By implementing this approach, also referred to as analytical performance management, different business entities can be proactive in noticing and adapting to new market conditions, thereby maintaining competitiveness in their industry (Zhang et al., 2023). Although some businesses argue that, in practice, performance analytics represent scheduled reporting, rapid digitalization and the volume of data that needs to be analyzed serve as evidence that performance analytics is much more than just reporting on past business activity to company management. It can be stated that performance analytics represents a bridge between past data and future forecasts, as it facilitates real-time reporting and enables decision-making based on outcomes from various analyses of historical data (Savic, Martic & Popovic, 2022).

The insurance sector, with its sophisticated risk models, large data stores and competitiveness is increasingly dependent on performance analytics for driving business simplification, decision-making. In terms of usage of performance analytics within the insurance industry, a number of benefits have been achieved, mainly in the areas of more informed and effective decision-making and driving higher productivity and operational efficiency. As the sector continues to evolve, performance analytics empowers insurance companies to anticipate trends in the future, fine-tune risk models and update business strategies (Jones & Sah, 2023). Increased application of performance analytics in many fields, among them the insurance industry, was anticipated, given the fact that a vast number of methods tend to be categorized as tools that help organizations monitor, evaluate and improve their performance. Among the many different methods, certainly some of the best known are Data Envelopment Analysis (DEA), which is used to assess the efficiency of peer entities, such as insurance companies, by comparing different input-output ratios. Alongside DEA, there are other quantitative approaches, such as Stochastic Frontier Analysis (SFA), as well as more qualitative ones, like Benchmarking, which identifies best practices against which other organizations. Another popular tool is the Balanced Scorecard, which focuses on four crucial perspectives: financial, internal processes, customer and learning and growth, allowing companies to align their performance metrics with long-term strategic goals. By leveraging large pools of information alongside the great analytical power of various methods, insurers can more accurately quantify risk, automate processes and deliver higher customer satisfaction. In return, this makes the organization more responsive, longer-lasting and able to keep up with an evolving marketplace. Most importantly, performance analytics is crucial for driving innovation, long-term success and competitiveness in the insurance market.

Given the fact that application of performance analytics concepts in many industries increases, the purpose of this research is to survey the application of performance analytics in the insurance business, its contribution to business improvement, risk management, and competitiveness. The review will cover the ways in which performance analytics helps insurance companies respond to market trends, make informed decisions and optimize business strategy. Through the investigation of the body of work in the existing literature, the research approaches applied will be established and compared, alongside their application in different areas, in order to gain a clear view of the real contribution of performance analytics to success in the insurance business.

2. Literature Sources and Search Approach

The literature search was restricted to a five-year period, from 2020 to 2024. The sections that follow briefly describe the search and screening methodology used for identifying topic-related papers.

2.1 Search procedure

The search process consists of three steps as illustrated in Figure 1.
The first step was to create a list of keywords associated with performance analytics and the insurance sector. Following the example of past studies (e.g., Kaffash et al., 2019; Cvetkoska & Savic, 2021), three sets of keywords were:

- Set 1 – **Performance-related keywords:** performance, performance measurement, efficiency, productivity, solvency and profitability;
- Set 2 – **Insurance-related keywords:** insurance industry, insurance sector, insurance companies, insurer, life insurance and non-life insurance;
- Set 3 – **Methodology-related keywords:** Data Envelopment Analysis, DEA, Stochastic Frontier Analysis, SFA, Benchmarking, frontier analysis, technical efficiency, scale efficiency and return to scale.

The second step was using the selected keywords to search for relevant papers among large collections of literature stored in major scientific databases, primarily the Web of Science, Scopus, ScienceDirect and finally Google Scholar. In the *third step*, the collected papers underwent a suitability analysis to determine

whether they aligned with the objectives of this research. A manual search was conducted to do a final check for potentially existing papers that correspond to the analyzed topic. Papers that passed the suitability analysis were selected for further analysis.

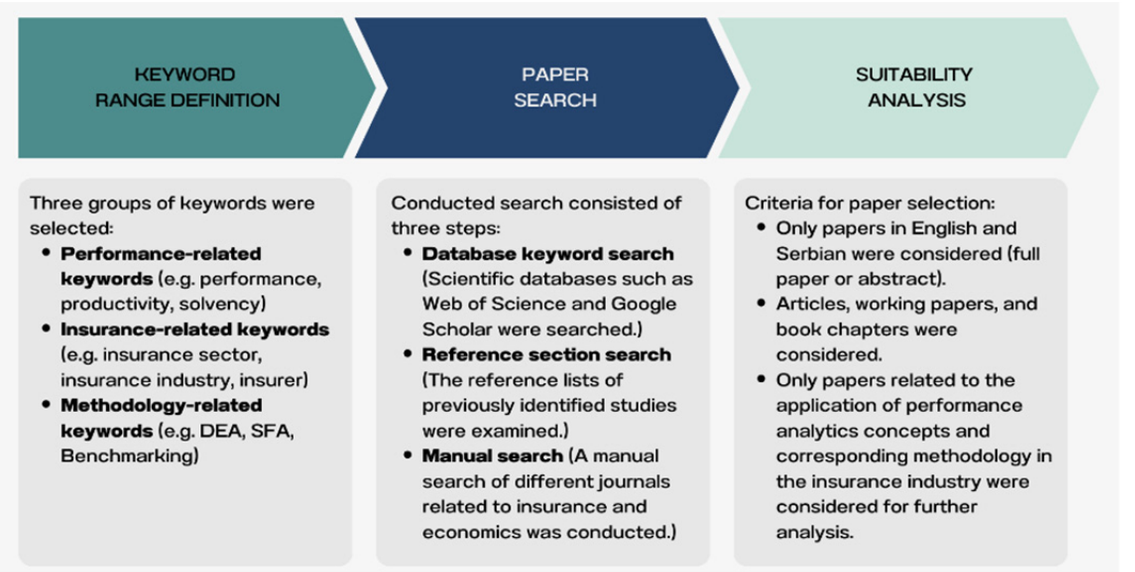


Figure 1: Search procedure

2.2 Paper screening and selecting

Suitability analysis consisted of paper screening and selection. In the screening phase, key elements of each paper were analyzed: title, abstract, and introduction. If necessary, some papers were completely analyzed to determine if they were relevant to this research.

- **First step** – Initially, 79 papers were identified as potentially suitable for this research according to keyword searches in large scientific databases. After screening, the number of suitable papers was reduced to 63.
- **Second step** – The reference sections of papers analyzed in step one were inspected resulting in the inclusion of five more papers.
- **Third step** – A manual search of journals and databases resulted in 16 more papers being added to the pool.

In total, 84 papers were obtained and categorized as relevant for this literature review. Further, bibliometric analysis and synthesis of these papers will follow.

3. Statistics and Bibliometric Analysis

The next step in this research was to conduct a bibliometric analysis of all the collected papers. The majority of the papers were individually analyzed and selected as suitable for this research. To perform the analysis, a Python script was developed to automatically retrieve bibliometric data from a provided list of references. This script returns key paper data, such as title, authors, affiliations, keywords, publisher, and year. Once compiled, the data were analyzed using specialized software, VOSviewer, for mapping and visualizing bibliometric and scientific data (Van Eck & Waltman, 2010) and Microsoft Excel.

3.1 Publication statistics

This section presents a more statistically-oriented analysis conducted on data related to the papers gathered.

• Statistics on publication per year

Figure 2 shows how analytics performance papers in the insurance industry domain are distributed over a five-year time span. Note that the number of papers grew significantly from 2020 to 2022, with the highest number of published articles in 2022 (25 published works, representing ~29.4% of all selected papers). After that, a significant decline occurred in 2023 and 2024.

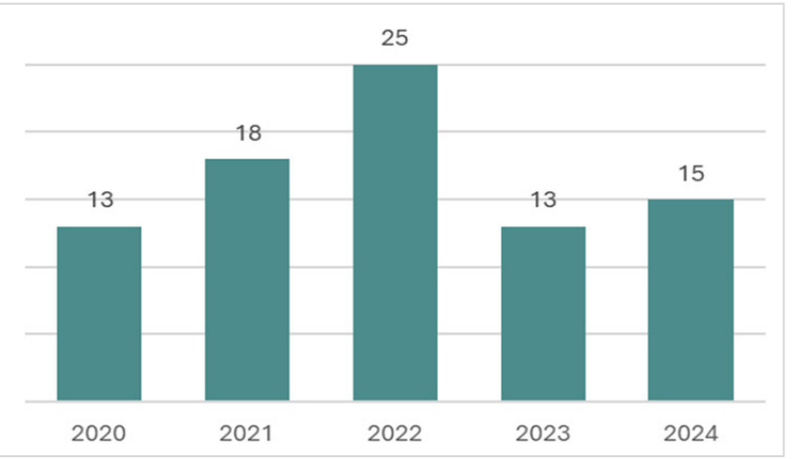


Figure 2: Distribution of papers over the years

• Statistics on publication per source

A total of 66 sources were identified from 85 analyzed papers. Table 1 presents the distribution of papers across these publishers, showing the number of papers per source. As presented, 14 sources are listed that have published the largest number of scientific papers related to performance analytics applications in the insurance industry. Of the total number of papers, 32 papers (or approximately 38%) were published by these sources. The scope in which the majority of all the papers are falls within the fields of economics, finance, risk management, business and management, as well as public policy and healthcare policy.

Table 1: Distribution of papers by source

No. of papers/ source	No. of source	Source name	No. of papers	% of total no. of papers
4	2	Cogent Economics & Finance, Journal of Asian Finance Economics and Business	8	9.52
2	12	Sustainability International Journal of Environmental Research and Public Health, Frontiers in Public Health, Journal of Applied Finance & Banking, Croatian Operational Research Review, Risk Management and Healthcare Policy, Decision Making: Applications in Management and Engineering, International Journal of Finance & Economics, Discover Sustainability, Managerial and Decision Economics, Ekonomi Politika & Finans Araştırmaları Dergisi, Geneva Papers on Risk and Insurance - Issues and Practice	24	28.57
1	52	Other publishers	52	61.9
Total	**66**		**84**	**100**

• Keywords statistics

The last part related to statistics is dedicated to keyword analysis. A total of 244 different keywords were identified among the evaluated papers. The average number of keywords per paper was 5.03. In order to better understand the structure of the used keywords, we analyzed keyword frequency in two groups: keywords related to performance analytics and keywords related to methodology. Table 2 illustrates keyword frequency for both groups.

Table 2: Topic-related and methodology-related keywords frequency

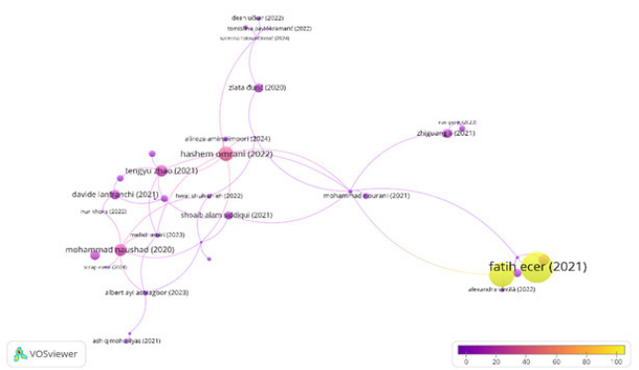
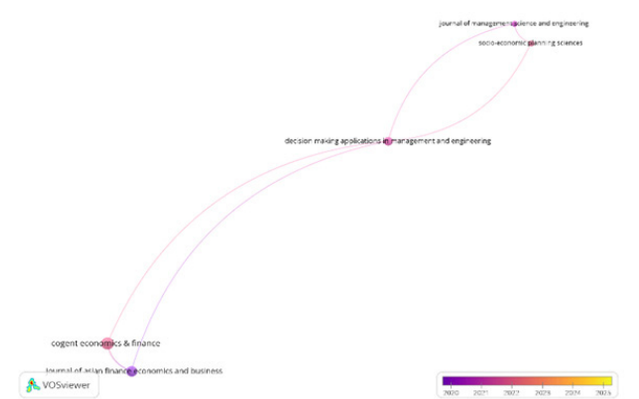
Topic-related keywords frequency			Methodology-related keywords frequency		
Rank	Keyword	Frequency	Rank	Keyword	Frequency
1	Efficiency	21	1	Data Envelopment Analysis	15
2	Insurance companies	18	2	Technical efficiency	11
3	Insurance	12	3	DEA	10
4	Productivity	5	4	Cost efficiency	5
4	Insurance sector	5	5	Stochastic Frontier Analysis	4
4	Financial performance	5	6	Malmquist index	3
5	Private health insurance	4			

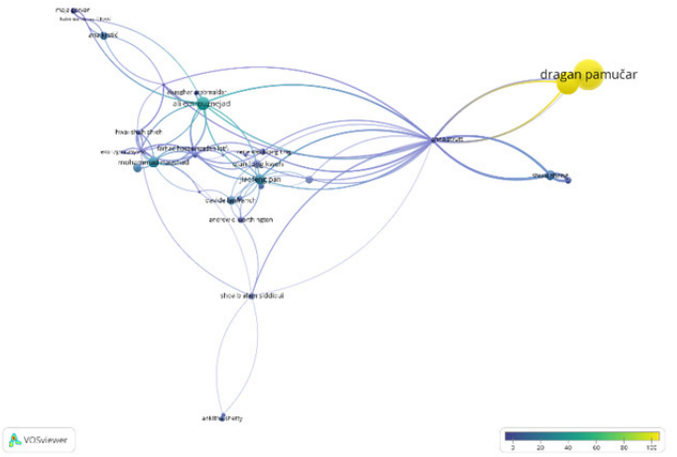
Efficiency is the most frequently occurring keyword as expected among the entire collection of studied papers. When it comes to the methodology section, there is no surprise that the most frequent keywords are related to DEA and technical efficiency, given that the majority of the papers employed this method for performance measurement.

3.2 Bibliometic evaluation

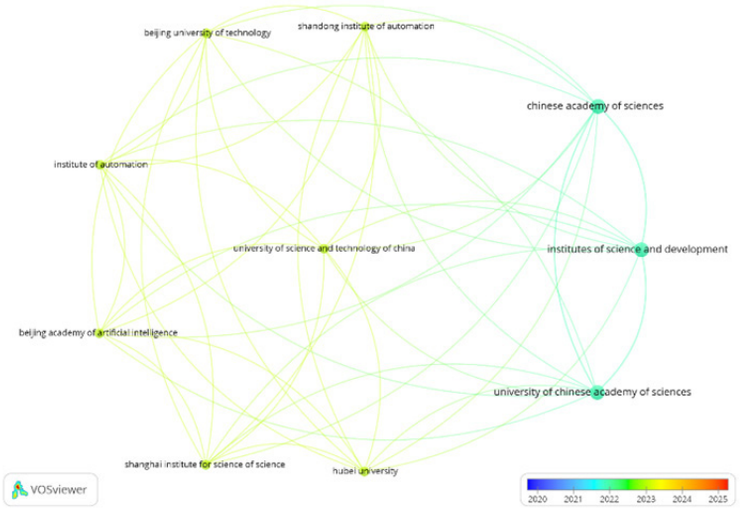
This section presents a bibliometric analysis of the gathered papers regarding performance analytics in insurance industries. For a better evaluation of the collected papers as part of the bibliometric review, two types of analyses were conducted: (1) citation analysis with three instances characterized by different units: papers, sources and authors and (2) co-authorship analysis with two instances characterized by different units – institutions and countries. The purpose of this analysis is to enable the observation and better understanding of patterns that represent collaborations, influence, and trends in the analyzed field according to the evaluated papers.

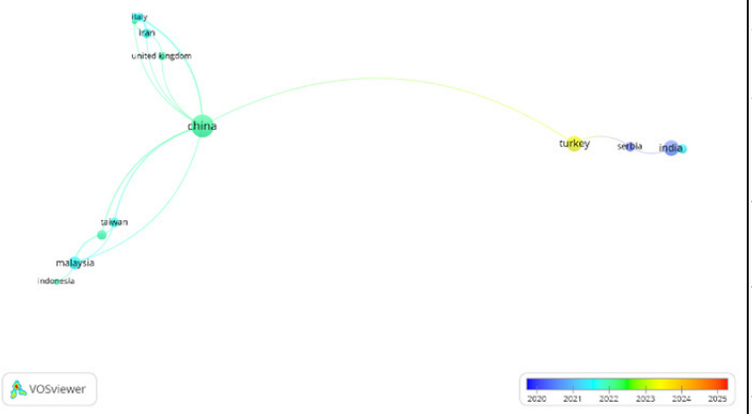
- **Citations analysis**

Units of analysis: **papers** (84 in total)	
	The paper with the most citations in the analyzed set is by Ecer and Pamucar (2021). Along with Gharizadeh Beiragh et al. (2020), it represents key works for authors interested in the same scientific domain. Among the 84 papers evaluated, Omrani et al. (2022) has the most citations and connections within the set. Upon analyzing the topics of the papers, most in the denser part of the network implement different variations one methodology used in performance analytics - Data Envelopment Analysis (DEA).
Units of analysis: source (66 in total, with the 5 most cited in the network)	
	The network shows the five sources with the most mutual citations among the analyzed papers. Interestingly, the journal called Decision making applications in management and engineering is the only one connected to all the other four. The other sources are divided into two clusters. Upon analyzing the fields that these sources correspond to, it was noticed that all of them are specialized in economics science and decision-making. As expected, the two sources with the most papers published, 4 for each source (see Table 1), are part of the most cited network.
Units of analysis: **authors** (251 in total)	

	The authors citation network clearly highlights some key researchers, such as Dragan Pamucar and Abbas Mardani, These two authors, along with Ramin Gharizadeh Beiragh, represent the most powerful cluster in the network, given that they are the only ones with an average number of citations close to 100. Most of the other authors have an average number of citations between 10 and 20 citations per author. Two others stand out with more citations than the majority of authors in the set: Maja Pervan from Croatia and Ana Krstic from Serbia.

• **Co–autorship analysis**

Units of analysis: **institutions** (124 in total, with the 10 most influential in the network)	
	As shown, the central places in the co-authorship network belong to Beijing University of Technology and Chinese Academy of Sciences, which highlights their influence in shaping scientific trends. The majority of key institutions are from China, suggesting that this nation plays a leading role in the field. Intensive networking between Chinese institutions indicating a strong focus on national collaborations. Additionally, upon careful analysis of the networks, it is clear that most Chinese institutions have collaborated more recently, especially in the past two years. It is observed that Beijing University of Technology, as a key institution, has more recent publications, primarily dating from 2023 and 2024.
Units of analysis: **countries** (36 in total, with the 10 most influential in the network)	

	Corresponding to the previous network, the co-authorship network containing countries also suggests that the biggest influence is derived from China, which takes a leading position in international cooperation. Alongside China, among the most influential countries, there are Italy, Iran, the UK, Taiwan, Malaysia and Indonesia. Although the majority of the most influential countries are from East and Southeast Asia, it is interesting that these countries are not the ones that have the majority of collaborations with India, also located in that part of the world. The country having the most co-authorships with India is Serbia. Most of the co-authorships between these two countries occurred during 2020 and 2021.

4. Overview of Performace Analytics in Insurance

For the 84 reviewed papers, the statistics were as follows: (1) 60 papers (approximately 71.5%) employed DEA as the primary methodology for the analysis and (2) the remaining 24 papers employed different methodologies. The proportions confirm that DEA is one of the most popular methods for performance analytics. Therefore, the further analysis will be divided into two parts: one focusing on non-DEA studies for performance assessment in the insurance industry and the other on DEA-specific research.

4.1 Overview of performance analytics in non-DEA studies

Table 3: Overview of performance analytics in non-DEA papers

REFERENCE		
Allodi et al. (2024)	Field	Examining the impact of the board gender diversity on the environmental performance of insurance companies.
	Methodology	A quantitative analysis of 53 insurance companies in Italy.
Alqirem et al. (2020)	Field	Investigating the relationship between ownership structure, earnings manipulation and organizational performance among Jordanian insurance companies.
	Methodology	Panel data analysis on secondary data gathered from insurance companies registered in the Jordanian market from 2009 to 2018, resulting in 200 observations.
Abebe, Abebe & Bezabih (2022)	Field	Examining the effect of corporate governance on financial performance in a highly regulated environment in Ethiopia.
	Methodology	An exploratory study on econometric panel data from 9 insurance companies between 2012 and 2020, using the random effects estimation technique.
Ecer & Pamucar (2021)	Field	Assessment and ranking of Turkish private health insurance companies during the COVID-19 outbreak.
	Methodology	The MARCOS technique implemented in an institutional fuzzy environment was used to rank insurance companies based on 7 different criteria defined by 5 experts.

REFERENCE		
Safi, Dorgham & Allaloul (2024)	Field	Investigation of the impact that management financial intelligence has on the financial performance of insurance companies in the Gaza Strip.
	Methodology	An approach based on descriptive analytics that assessed financial performance by measuring ROI, ROA, and ROE for data gathered from 11 insurance companies in 2022.
Isik, Calik & Shabir (2024)	Field	The performance of Turkish non-life insurance companies listed on Borsa Istanbul during a five-year period, from 2015 to 2019, was examined.
	Methodology	A hybrid model that combines the Pythagorean Fuzzy Analytic Hierarchy Process (PFAHP) and the Multi-Attributive Ideal-Real Comparative Analysis (MAIRCA).
Sang & Hung (2024)	Field	The impact of sustainable competitive advantage on the performance of Vietnamese insurance companies was examined under the regulating effect of government policies in the context of Industry 5.0.
	Methodology	Data from 248 leading insurance companies were examined in a two-step application of the PLS-SEM method.
Msomi (2023)	Field	Examining the financial performance of 121 listed insurance companies from 48 African countries for the period 2008-2019.
	Methodology	Panel data (1452 observations) were analyzed using two-step System Generalised Method of Moments estimators and ordinary least squares.
Lukic (2021)	Field	Efficiency analysis of insurance companies in Serbia based on different types of insurance.
	Methodology	Combined Compromise Solution (COCOSO) method
Mamatzakis et al. (2024)	Field	Providing a comprehensive overview of the performance of entities in the U.K. insurance market from 1996 to 2017.
	Methodology	Stochastic Frontier Analysis (SFA) method
Morara & Sibindi (2021)	Field	An exploration of the components contributing to the financial performance of insurance companies in Kenya.
	Methodology	Panel data from 37 general and 16 life insurers (2009–2018) were analyzed by using pooled OLS, fixed effects and random effects models.
Sinha, Cvetkoska & Peovski (2022)	Field	Examining the impact of environmental variables on the efficiency performance of 15 Indian insurance companies from 2011 to 2017.
	Methodology	Two-stage approach: (1) a convex nonparametric least squares method for efficiency evaluation and (2) quantile regression to explore the impact of environmental variables.
Demir (2022)	Field	Proposing an integrated model using the PSI-SD and MABAC methods and validating it through measuring and evaluating the performance of the Turkish insurance firm Anadolu Sigorta
	Methodology	Two-stage approach: (1) PSI and SD methods for weight coefficients and (2) the Bayesian approach and MABAC for performance ranking.
Xiong (2022)	Field	Examining the operational efficiency of the basic pension insurance system for urban and rural residents in China using a multi-attribute group decision-making approach.
	Methodology	TOPSIS method combined with cumulative prospect theory (CPT) and picture fuzzy sets (PFSs)
Sasidharan et al. (2020)	Field	Examining the financial performance of 18 insurance firms in the UAE stock market based on firm-specific and macroeconomic factors.
	Methodology	Correlation and Multiple linear regression analysis
Tunay & Tunay (2023)	Field	Investigate the impact of inflation on the performance of insurance companies in Turkiye.
	Methodology	Time series analysis, causality tests and autoregressive models
Dwivedi et al. (2021)	Field	Performance evaluation of insurance companies, focusing on synchronizing organizational performance with its vision, mission and strategy.
	Methodology	Proposed approach that integrates the Balanced Scorecard (BSC) and Best-Worst Method (BWM) models.

REFERENCE		
Tasci (2024)	Field	Assessing and ranking the multidimensional performance of insurance companies in Turkey.
	Methodology	The ENTROPY and MEREC methods determined the weights of performance indicators, while the MACONT method ranked overall performance.
Ulansari & Septiarini (2020)	Field	Analyzing and comparing the efficiency of conventional insurance companies and Islamic Sharia Business Units (ISBU) in Indonesia.
	Methodology	Stochastic Frontier Analysis (SFA) method
Ortynski & Woloszyn (2022)	Field	Examining the (technical) efficiency levels and structure of life insurance companies in Poland for the period from 2011 to 2020.
	Methodology	Stochastic Frontier Analysis (SFA) method
Nasution (2021)	Field	Evaluateing the efficiency of Indonesian sharia insurance and Malaysian takaful
	Methodology	Stochastic Frontier Analysis (SFA) method
Kholis & Afifah (2022)	Field	Comparing the efficiency between conventional insurance companies and Sharia insurance, both groups involving general and life insurance, in Indonesia for the two-year period (2018-2020).
	Methodology	Stochastic Frontier Analysis (SFA) method
Giantsios & Noulas (2020)	Field	Examining the impact of the Eurozone crisis (which began in 2009) on efficiency levels and the insurance integration process in the European Union over the period from 2006 to 2014.
	Methodology	(1) Stochastic Frontier Analysis (SFA) was used to estimate cost efficiency for 947 non-life insurance firms, and (2) the Generalized Method of Moments (GMM) was applied to assess β-convergence and σ-convergence.
Jarraya, Afi & Omri (2023)	Field	Proposing a three-step approach designed to help create an optimal product plan and assess profit efficiency for non-life insurance companies in Europe for the period from 2008 to 2014.
	Methodology	The Lagrangian function and Directional Output Distance Function were applied in a three-step approach to estimate frontier parameters, create an optimal production plan and assess efficiency.

4.2 Overview of performance analytics in DEA-related studies

The majority of the analyzed papers implemented a performance analytics approach using the DEA methodology. The analysis is organized into three sections: (1) Used inputs, outputs, measured efficiency and an overview of DEA models, (2) Studies implementing multistage DEA and specific variations of DEA and (3) Studies using Malmquist indices. In order to identify and compare the most commonly applied input and output indicators in DEA-based studies, an additional set of 26 papers was used directly in the empirical analysis. These papers were part of the analytical dataset that served as the foundation for determining indicator frequency and classification patterns across DEA applications in the insurance sector (Amirteimoori et al., 2024; Bhatia & Mahendru, 2022; Che Mohd Salleh et al., 2022; Chong et al., 2024; Djuric et al., 2020; Fotova Cikovic et al., 2024; Ghosh et al., 2021; Ilkaz & Cebi, 2024; Li et al., 2021a; Lukic, 2023; Mahad et al., 2021; Mitrovic et al., 2020; Musa et al., 2022; Naushad et al., 2020; Nourani et al., 2021; Pavic Kramaric et al., 2022; Pervan et al., 2021a; Pervan et al., 2021b; Shetty & Basri, 2020; Siddiqui, 2022; Siddiqui & Shaddady, 2023; Suarez-Fernandez et al., 2021; Trinh, 2024; Uckar & Petrovic, 2022; Worthington & Nguyen, 2024; Zhao et al., 2021).

- **Inputs, outputs, efficiency and DEA models**

Table 4 displays the DEA inputs with 4 or more occurrences and the DEA outputs with 3 or more occurrences.

Table 4: Inputs and outputs frequency

Inputs	Frequency	Outputs	Frequency
operating expenses	9	investment income	7
debt capital	6	premiums*	3
equity capital	6	premium revenue	3
fund income	4	net profit	3
capital	4	fund expenditure	3
management expenses	4	*Referred to as the amount of money paid by a client for an insurance policy.	
total assets	4		
total equity	4		

The most frequent inputs and outputs, as presented in Table 4, represent some of the key metrics that directly influence the stability and profitability of an insurance company. Therefore, it is justified that authors of DEA-related papers used these indicators, as they provide detailed performance evaluation and highlight areas for improvement.

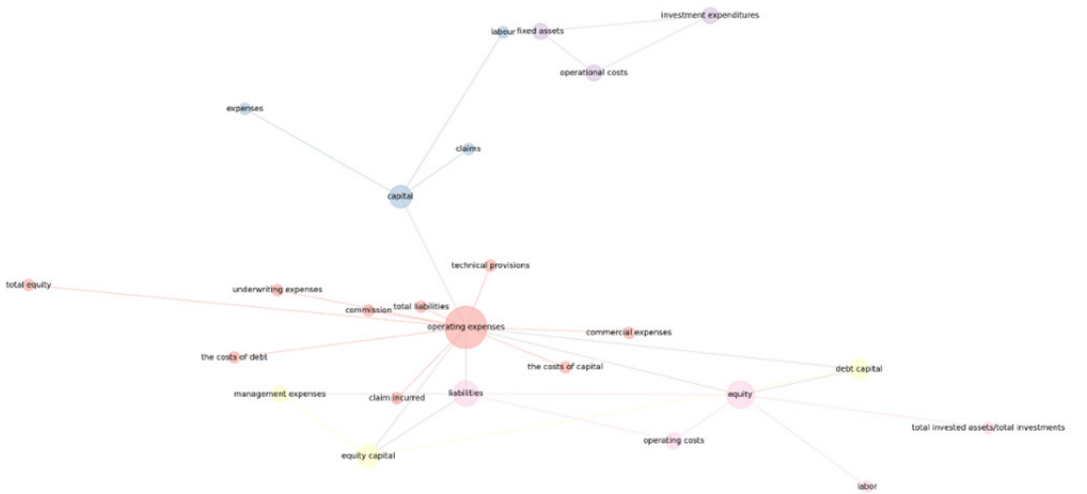


Figure 3: Input network

Figure 3 shows the clusters of inputs used in the DEA analysis. Significant inputs with high influence on operations, such as operational expenditure, investment, liabilities and capital, are the centroids of the large clusters. The largest cluster, the red cluster, is the “operational costs and resource efficiency” cluster and contains inputs such as operating expenses, commercial expenditures, underwriting expenses and total liabilities. These inputs express the extent to which a given entity (in this case, an insurance company or firm) controls the resources required and the expenses of its activities, which is generally accepted to be a value proportionate to rising efficiency. The second largest cluster, the blue cluster, is the “capital-related” cluster, with labour and capital at its centre. It highlights the role of human and financial capital in the scenario of optimization of efficiency. Similarly to Figure 3, Figure 4 illustrates the output clusters. The largest cluster in this network, the purple cluster, which may be referred to as the “income” cluster, contains its members, including investment income, net profit, earned premiums and gross premiums, referring to different types of income. This team is a key determinant of how effectively an organization makes money and converts inputs into money.

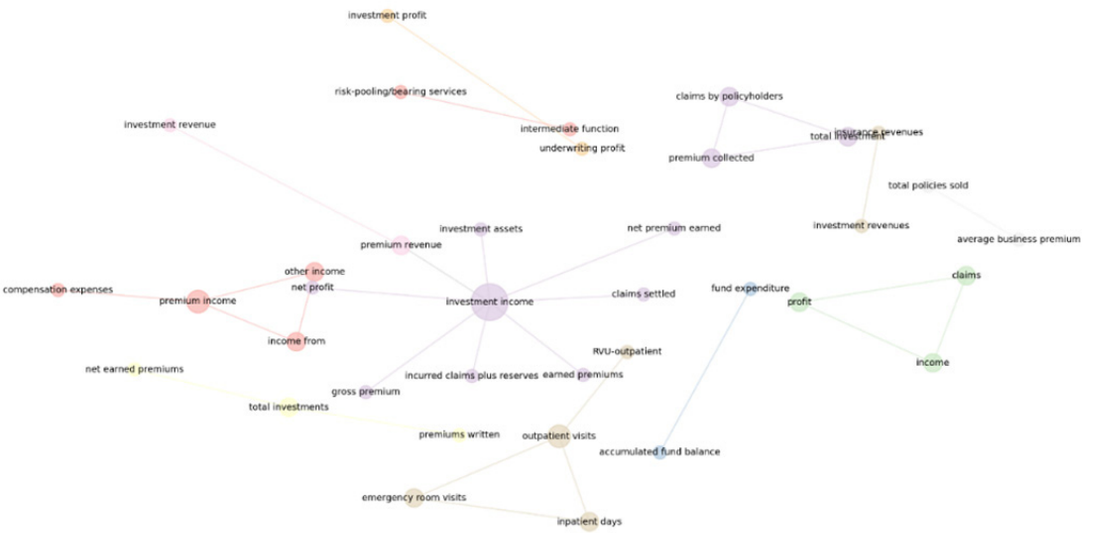


Figure 4: Output network

DEA is a nonparametric method that uses mathematical models to measure efficiency and compare performance among peer entities, with a focus on various types of efficiencies. Figure 5 displays the five identified categories of efficiencies measured. The most common category is technical efficiency, which was assessed in 32 papers. The least common are cost and profit efficiency, with three papers each. Figure 6 shows the prevalence of DEA models applied, with most papers using fundamental DEA models. The BCC model was applied in 14 papers, and the CCR model in 11. In combination, they were used in a total of 12 analyzed studies. Overall, 37 papers used the basic DEA models, either solely or in combination with other methods. Of these 37 papers, 30 utilized input-oriented models, which seek to reduce required inputs for specified outputs

Figure 5: Types of efficiency

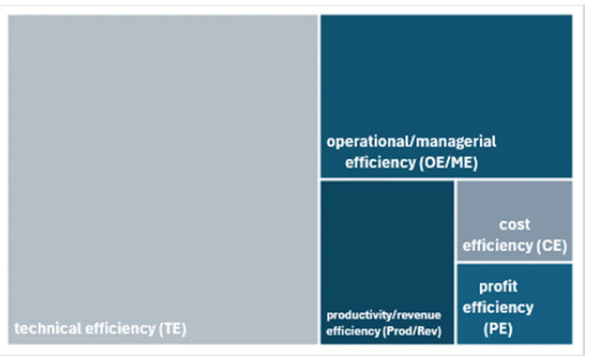
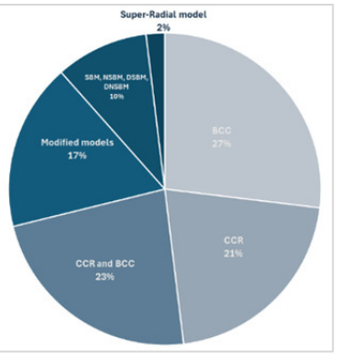


Figure 6: DEA models



- **Studies implementing multistage DEA and specific variations of DEA**

Table 5 illustrates studies that employed multistage DEA or some specific variations of DEA, along with the field of study.

Table 5: Multistage/special variations DEA

REFERENCE	Multistage/ Spec. var.	Field
Zhang et al. (2023)	Dynamic DEA	Examining the long-term operational performance and resilience of Chinese insurance companies.
Shieh et al. (2022)	Two-stage DEA	Measuring and benchmarking the comparative operating efficiency between insurance companies in Taiwan and mainland China.
Yang et al. (2021)	Two-stage DEA	Examining hospital resource allocation efficiency in Taiwan's NHI system, focusing on the impact of the 2002 global budgeting scheme.
Nguyen & Worthington (2021)	Two-stage DEA	Examining the technical efficiency of Australian private health insurers from 2010 to 2017.
Peng et al. (2023)	Three-stage DEA	Analyzing the operational efficiency of urban employee basic medical insurance (UEBMI) across 31 provinces in China.
Lanfranchi & Grassi (2021)	Two-stage DEA	Assessing the impact of Insurtech innovations, such as AI and blockchain, on the efficiency of US public P&C insurance companies.
Li et al. (2021b)	Three-stage DEA	Measuring the operating efficiency of China's basic pension insurance across 31 provinces.
Liu et al. (2022)	Three-stage DEA	Analyzing the efficiency of basic health insurance for urban and rural residents in China, focusing on the efficiency of medical insurance fund expenditure.
Sanei et al. (2022)	Two-stage DEA-ANN-GA framework	Proposing a novel artificial intelligence technique for near-optimal resource management by combining two-stage DEA, Artificial Neural Networks (ANN) and Genetic Algorithms (GA).
Gharizadeh Beiragh et al. (2020)	AHP–PCA–DEA	Proposing an integrated approach for sustainability performance assessment in insurance companies, combining Principal Component Analysis (PCA), Analytic Hierarchy Process (AHP) and DEA.
Qu et al. (2022)	Robust DEA	Evaluating the efficiency of endowment insurance system in China, while addressing uncertainty through robust optimization.
Reyna et al. (2021)	Two-stage DEA	Examining the impact of prolonged low interest rates on the efficiency of the insurance industry in Mexico.
Bansal & Singh (2021)	Two-stage DEA	Evaluating the technical efficiency of listed insurance companies in GCC countries.
Xie et al. (2023)	Multiperiod DEA model	Evaluating the operating efficiency of insurance companies in China for the period 2009-2018.
Alhassan & Boakye (2020)	Two-stage DEA	Evaluating the effect of corporate governance attributes on technical efficiency of life insurance industry in the South Africa.
Anyomi (2023)	Modified MSBM-DEA methodology	Examining the technical efficiency of mutual versus stock organizational forms in the U.S. property-liability insurance industry.
Omrani et al. (2022)	Two-stage Network DEA	Proposing a linear goal programming model, transform negative data into positive, undesirable outputs into desirable ones and incorporating data uncertainty using the fuzzy alpha-cut approach.
Abdin et al. (2022)	Two-stage DEA	Analyzing the performance of general insurance companies in Indonesia for the 2017-2018.
Amiri et al. (2023)	Fuzzy DEA	Measuring the efficiency of insurance companies considering fuzzy data and uncertainty, based on expert views.
Xue & Ma (2022)	Three-stage superefficient SBM-DEA	Evaluation of the efficiency and effectiveness of the pension insurance system in China across 31 provinces from 2016 to 2020.

REFERENCE	Multistage/ Spec. var.	Field
Fernandez et al. (2024)	Two-stage DEA	Examining the relationship between efficiency scores and profitability ratios in the Spanish non-life insurance market from 2008-2017.
Ye et al. (2022)	Three-stage DEA	Analyzing the operational efficiency of urban employee pension insurance funds in China from 2011 to 2020.
Esmaeili et al. (2021)	Two-stage Network DEA	Examining productivity changes and stage efficiencies in the Iranian insurance industry using a two-stage Network DEA approach under data uncertainty.

- **Malmquist indices**

Table 6 shows studies using Malmquist productivity indices to evaluate insurance companies' efficiency, relevant for DEA-based research due to their reliance on mathematical models for optimizing economic systems.

Table 6: Malmquist indices studies

REFERENCE	Field
Abidi et al. (2020)	Calculating efficiency change, technological progress, and productivity growth in Australian private health insurance (PHI) funds, while analyzing the impact of the COVID-19 pandemic.
Ashiagbor et al. (2023)	Measuring efficiency and productivity changes in the life insurance industry in Ghana for period 2015-2020.
Nourani et al. (2020)	Investigating the productivity changes of Malaysian insurers from 2009 to 2017.
Kweh et al. (2024)	Investigating the productivity changes of Malaysian insurers from 2009 to 2017.
Maliha (2020)	Analyzing the productivity level of the Islamic insurance industry in Indonesia.
Ilyas & Rajasekaran (2022)	Measuring the changes and sources of changes in total factor productivity (TFP) of the Indian non-life insurance sector for period 2005-2016.
Siddiqui (2021)	Investigating the productivity growth of Indian life insurance companies.
Bakhouche et al. (2023)	Identifying the main drivers of productivity for 98 conventional and Sharia insurance companies in Jordan and GCC countries.
Vurur & Ozdemir (2024)	Examining the efficiency changes of insurance companies listed on the Istanbul Stock Exchange from 2016 to 2020.
Nguyen & Nguyen (2022)	Assessing the efficiency dynamics of Vietnam's life and non-life insurance sectors from 2016 to 2020 using a value-added DEA and Malmquist Productivity Index approach.

Discussion and Conclusion

According to the bibliometric analysis, scientific literature on performance analytics applies to all business levels, particularly to insurance companies. Generally, healthcare insurance companies are the primary focus of performance analytics in the majority of the papers.

Furthermore, the keyword analysis of the evaluated papers revealed significant insights into current trends and focal points within the field of performance analytics in insurance. Over the past five years, efficiency analysis has emerged as the dominant thematic keyword, underscoring its importance in understanding organizational performance. This finding aligns with the overarching goal of performance analytics, which is to measure and enhance operational efficiency in insurance. For insurance company management and researchers, further development largely depends on improving efficiency.

Regardless of the type of efficiency measured, Data Envelopment Analysis (DEA) is emphasized as the most commonly employed technique. This is due to DEA's ability to include a variety of inputs and outputs in the analysis. DEA approaches demonstrate notable diversity, characterized by the use of various models and frameworks, including dynamic analysis and total factor productivity change analysis using Malmquist indices.

Cluster analysis of input indicators used in the research papers shows that special attention must be given to controlling resource usage and operational expenses, followed by optimizing labour and capital. On the other hand, the most significant output cluster is referred to as the "income" cluster, which includes investment income, net profit, earned premiums, and gross premiums—different types of income that reflect the effectiveness of converting inputs into profit. Non-DEA studies explore critical areas such as corporate governance and environmental performance, reflecting a broader understanding of the factors that influence insurance firms' performance beyond traditional efficiency metrics.

REFERENCES

[1] Abdin, Z., Prabantarikso, R., Fahmy, E., & Farhan, A. (2022). Analysis of the efficiency of insurance companies in Indonesia. *Decision Science Letters*, *11*(2), 105–112. DOI: 10.5267/j.dsl.2022.1.002

[2] Abebe Zelalem, B., Ali Abebe, A., & Wodajo Bezabih, S. (2022). Corporate governance and financial performance in the emerging economy: The case of Ethiopian insurance companies. *Cogent Economics & Finance*, *10*(1), 2117117. DOI: 10.1080/23322039.2022.2117117

[3] Abidi, I., Nsaibi, M., & Regaieg, B. (2020). Challenges of Islamic insurance. *International Journal of Economics and Financial Issues*, *10*(4), 69. DOI: 10.32479/ijefi.9860

[4] Alhassan, A. L., & Boakye, M. A. A. (2020). Board characteristics and life insurance efficiency in South Africa. *Pacific Accounting Review*, *32*(2), 217–237. DOI: 10.1108/PAR-06-2019-0066

[5] Allodi, E., Ammari, A., Salerno, D., & Stella, G. P. (2024). Environmental Performance in Insurance Companies: The Role of Women. *International Journal of Finance & Economics*. DOI: 10.1002/ijfe.3054

[6] Alqirem, R., Abu Afifa, M., Saleh, I., & Haniah, F. (2020). Ownership structure, earnings manipulation, and organizational performance: The case of Jordanian insurance organizations. *The Journal of Asian Finance, Economics and Business*, *7*(12), 293–308. DOI: 10.13106/jafeb.2020.vol7.no12.293

[7] Amiri, M., Rostamy-Malkhalifeh, M., Lotfi, F. H., & Mozaffari, M. (2023). Measuring returns to scale based on the triangular fuzzy DEA approach with different views of experts: Case study of Iranian insurance companies. *Decision Making: Applications in Management and Engineering*, *6*(2), 787–807. DOI: 10.31181/dmame622023740

[8] Amirteimoori, A., Allahviranloo, T., & Arabmaldar, A. (2024). Scale elasticity and technical efficiency measures in two-stage network production processes: An application to the insurance sector. *Financial Innovation*, *10*(1), 43. DOI: 10.1186/s40854-024-00624-4

[9] Anyomi, S. K. (2023). Efficiency: Mutual vs. Stock PL Insurers. *Finance Research Letters*, *53*, 103631. DOI: 10.1016/j.frl.2023.103631

[10] Ashiagbor, A. A., Dziwornu, R., Gbade, A. V., Offei-Kwafo, K., & Liticia, G. (2023). Measuring efficiency and productivity changes: A non-parametric analysis of Ghanaian life insurance industry. *Cogent Economics & Finance*, *11*(1), 2210855. DOI:10.1080/23322039.2023.2210855

[11] Bakhouche, A., Zabalawi, E., & Boulkeroua, M. L. (2023). Evaluating the sources of productivity of insurance firms in Arab gulf countries and Jordan: Malmquist productivity index. *Afro-Asian Journal of Finance and Accounting*, *13*(4), 478–501.

[12] Bansal, R., & Singh, D. (2021). Efficiency drivers of insurers in GCC: An analysis incorporating company-specific and external environmental variables. *Cogent Economics & Finance*, *9*(1), 1922179. DOI: 10.1080/23322039.2021.1922179

[13] Bhatia, A., & Mahendru, M. (2022). Revenue efficiency evaluation of life insurance companies in India: Identification of leaders and laggards. *Benchmarking: An International Journal*, *29*(10), 3133–3162. DOI: 10.1108/BIJ-01-2021-0051

[14] Che Mohd Salleh, M., Chowdhury, M. A. M., Cahyono, E. F., & Widiastuti, T. (2022). Measuring the effect of GST towards performances of Malaysian takaful operators. *Journal of Islamic Accounting and Business Research*, *13*(6), 977–993. DOI: 10.1108/JIABR-06-2020-0193

[15] Chong, J. K., Lee, H. S., & Liew, P. X. (2024). Is takaful (Islamic insurance) more efficient than conventional insurance? A comparative analysis of the Malaysian insurance industry. *International Journal of Business & Society*, *25*(2). DOI: 10.33736/ijbs.7611.2024

[16] Cvetkoska, V., & Savic, G. (2021). DEA in banking: Analysis and visualization of bibliometric data. *Data Envelopment Analysis Journal*, *5*(2), 455-485. DOI: 10.1561/103.00000044

[17] Demir, G. (2022). Hayat dýsý sigorta sektorunde kurumsal performansýn PSI-SD tabanlý MABAC metodu ile olculmesi: Anadolu Sigorta ornegi. *Ekonomi Politika ve Finans Arastýrmalarý Dergisi*, *7*(1), 112–136. DOI: 10.30784/epfad.1072645

[18] Djuric, Z., Jaksic, M., & Krstic, A. (2020). DEA window analysis of insurance sector efficiency in the Republic of Serbia. *Economic Themes*, *58*(3), 291–310. DOI: 10.2478/ethemes-2020-0017

[19] Dwivedi, R., Prasad, K., Mandal, N., Singh, S., Vardhan, M., & Pamucar, D. (2021). Performance evaluation of an insurance company using an integrated Balanced Scorecard (BSC) and Best-Worst Method (BWM). *Decision Making: Applications in Management and Engineering*, *4*(1), 33–50. DOI: 10.31181/dmame2104033d

[20] Ecer, F., & Pamucar, D. (2021). MARCOS technique under intuitionistic fuzzy environment for determining the COVID-19 pandemic performance of insurance companies in terms of healthcare services. *Applied Soft Computing*, *104*, 107199. DOI: 10.1016/j.asoc.2021.107199

[21] Esmaeili, F. S. S., Rostamy-Malkhalifeh, M., & Lotfi, F. H. (2021). Interval network Malmquist productivity index for examining productivity changes of insurance companies under data uncertainty: A case study. *Journal of Mathematical Extension*, *16*. DOI: 10.30495/JME.2022.1503

[22] Fernandez, S. S., Quiroga-Garcia, R., & Perez, I. M. M. (2024). Studying the relation between efficiency and profitability in the non-life insurance market. *Revista de Métodos Cuantitativos para la Economía y la Empresa*, *37*, 1–20. DOI: 10.46661/rev.metodoscuant.econ.empresa.8054
[23] Fotova Cikovic, K., Cvetkoska, V., & Mitreva, M. (2024). Investigating the efficiency of insurance companies in a developing country: A data envelopment analysis perspective. *Economies*, *12*(6), 128. DOI: 10.3390/economies12060128
[24] Gharizadeh Beiragh, R., Alizadeh, R., Shafiei Kaleibari, S., Cavallaro, F., Zolfani, S. H., Bausys, R., & Mardani, A. (2020). An integrated multi-criteria decision making model for sustainability performance assessment for insurance companies. *Sustainability*, *12*(3), 789. DOI: 10.3390/su12030789
[25] Ghosh, A., Sarkar, A., Dey, M., Guha, B., Jana, S., & Ghorui, N. (2021). Analyzing efficiency of Indian life insurance companies using DEA and SEM. *Turkish Journal of Computer and Mathematics Education*, *12*(12), 3897–3919. DOI: 10.17762/turcomat.v12i12.8178
[26] Giantsios, D. G., & Noulas, A. G. (2020). Cost efficiency and convergence in the European nonlife insurance industry. *Journal of Applied Finance and Banking*, *10*(6), 117–133.
[27] Ilkaz, A., & Cebi, F. (2024). Multi-criteria decision-making model for evaluation of financial performance of insurance companies. In *Chaos, complexity, and sustainability in management* (pp. 141–170). IGI Global. DOI: 10.4018/979-8-3693-2125-6.ch008
[28] Ilyas, A. M., & Rajasekaran, S. (2022). Total factor productivity of the non-life insurers in India: Malmquist index with a new decomposition. *International Journal of Emerging Markets*, *17*(6), 1446–1464. DOI: 10.1108/IJOEM-10-2019-0869
[29] Isik, O., Calik, A., & Shabir, M. (2024). A consolidated MCDM framework for overall performance assessment of listed insurance companies based on ranking strategies. *Computational Economics*, 1–42. DOI: 10.1007/s10614-024-10578-5
[30] Jarraya, B., Afi, H., & Omri, A. (2023). Analyzing the profitability and efficiency in European non-life insurance industry. *Methodology and Computing in Applied Probability*, *25*(2), 68. DOI: 10.1007/s11009-023-10043-0
[31] Jones, K. I., & Sah, S. (2023). The implementation of machine learning in the insurance industry with big data analytics. *International Journal of Data Informatics and Intelligent Computing*, *2*(2), 21. DOI: 10.59461/ijdiic.v2i2.47
[32] Kaffash, S., Azizi, R., Huang, Y., & Zhu, J. (2019). A survey of data envelopment analysis applications in the insurance industry 1993–2018. *European Journal of Operational Research*, *275*(1), 1–15. DOI: 10.1016/j.ejor.2019.07.034
[33] Kholis, N., & Afifah, Y. N. (2022). Measuring financial efficiency of insurance companies in Indonesia using Stochastic Frontier Analysis approach: A comparison between Islamic and conventional insurances. *Journal of Islamic Economics Lariba*, *8*(1), 196–212. DOI: 10.20885/jielariba.vol8.iss1.art12
[34] Kweh, Q. L., Downing, K., Lu, W. M., & Ting, I. W. K. (2024). Productivity changes of insurers: Metafrontier Malmquist productivity index and a bootstrapping approach. *The Singapore Economic Review (SER)*, *69*(7), 2259–2280. DOI: 10.1142/S0217590820500344
[35] Lanfranchi, D., & Grassi, L. (2021). Translating technological innovation into efficiency: The case of US public P&C insurance companies. *Eurasian Business Review*, *11*(4), 565–585. DOI: 10.1007/s40821-021-00189-7
[36] Li, C., Wang, S. F., Liu, X. H., & Wang, L. (2021a). Does the development of the insurance industry promote the purchase of rural commercial health insurance? *Frontiers in Public Health*, *9*, 695121. DOI: 10.3389/fpubh.2021.695121
[37] Li, Z., Si, X., Ding, Z., Li, X., Zheng, S., Wang, Y., Wei, H., Guo, Y., & Zhang, W. (2021b). Measurement and evaluation of the operating efficiency of China's basic pension insurance: Based on three-stage DEA model. *Risk Management and Healthcare Policy*, 3333–3348. DOI: 10.2147/RMHP.S320479
[38] Liu, T., Gao, Y., Li, H., Zhang, L., & Sun, J. (2022). Analysis of the operational efficiency of basic medical insurance for urban and rural residents: Based on a three-stage DEA model. *International Journal of Environmental Research and Public Health*, *19*(21), 13831. DOI: 10.3390/ijerph192113831
[39] Lukic, R. (2021). Analysis of the efficiency of insurance companies by lines of insurance in Serbia using the COCOSO method. *Tokovi osiguranja*, *37*(2), 9–38. DOI: 10.5937/TokOsig2102009L
[40] Lukic, R. (2023). Analysis of the efficiency of insurance companies in Serbia. *Revija za ekonomske in poslovne vede*, *10*(2), 47–64. DOI: 10.55707/eb.v10i2.128
[41] Mahad, N. F., Abd Aziz, N. A., Amin, F. A. M., & Mahyideen, J. M. (2021). An integrated DEA and PROMETHEE II method for complete ranking: An application in life-insurance sector. *Journal of Academic Research in Business and Social Sciences*, *11*(10), 982–992. DOI: 10.6007/IJARBSS/v11-i10/11123
[42] Maliha, H. (2020). Technological and efficiency change on Indonesian Islamic insurance industry. *Ekonomi Islam Indonesia*, *2*(2). DOI: 10.58968/eii.v2i2.46
[43] Mamatzakis, E., Staikouras, C., Triantopoulos, C., & Wang, Z. C. (2024). Measuring the efficiency and productivity of UK insurance market. *International Journal of Finance & Economics*, *29*(1), 1097–1114. DOI: 10.1002/ijfe.2723

[44] Mitrovic, Dj., Trifunovic, D., & Randjelovic, S. (2020). Measuring efficiency of Serbian insurance companies using network data envelopment analysis. *Insurance market after COVID-19*, University of Belgrade–Faculty of Economics, 279–298.
[45] Morara, K., & Sibindi, A. B. (2021). Determinants of financial performance of insurance companies: Empirical evidence using Kenyan data. *Journal of Risk and Financial Management*, *14*(12), 566. DOI: 10.3390/jrfm14120566
[46] Msomi, T. S. (2023). Macroeconomic and firm-specific determinants of financial performance: Evidence from non-life insurance companies in Africa. *Cogent Business & Management*, *10*(1), 2190312. DOI: 10.1080/23311975.2023.2190312
[47] Musa, M., Alhabshi, S. M., & Haron, R. (2022). Optimization of solvency margin in family Takaful and life insurance institutions in Malaysia: Application of data envelopment analysis. *Journal of Islamic Accounting and Finance Research*, *4*(1). DOI: 10.21580/jiafr.2022.4.1.8792
[48] Nasution, Z. (2021). Sharia insurance efficiency in Indonesia and Malaysia using the stochastic frontier approach analysis. *Asian Journal of Islamic Management (AJIM)*, 123–136. DOI: 10.20885/AJIM.vol3.iss2.art5
[49] Naushad, M., Faridi, M. R., & Faisal, S. (2020). Measuring the managerial efficiency of insurance companies in Saudi Arabia: A data envelopment analysis approach. *The Journal of Asian Finance, Economics and Business*, *7*(6), 297–304. DOI: 10.13106/jafeb.2020.vol7.no6.297
[50] Nguyen, B. N., & Nguyen, P. A (2022). An investigation of the efficiency of insurance companies in Vietnam—Using data envelopment analysis and Malmquist index. *The Journal of Asian Finance, Economics and Business*, *9*(7), 261–271. DOI: 10.13106/jafeb.2022.vol9.no7.0261
[51] Nguyen, L., & Worthington, A. C. (2021). Industry regulation, fund characteristics, and the efficiency of Australian private health insurers. *Accounting & Finance*, *61*(1), 781–801. DOI: DOI: 10.1111/acfi.12593
[52] Nourani, M., Kweh, Q. L., Devadason, E. S., & Chandran, V. G. R. (2020). A decomposition analysis of managerial efficiency for the insurance companies: A data envelopment analysis approach. *Managerial and Decision Economics*, *41*(6), 885–901. DOI: 10.1002/mde.3145
[53] Nourani, M., Kweh, Q. L., Ting, I. W. K., Lu, W. M., & Strutt, A. (2021). Evaluating traditional, dynamic and network business models: An efficiency-based study of Chinese insurance companies. *The Geneva Papers on Risk and Insurance: Issues and Practice*, 1–39. DOI: 10.1057/s41288-021-00246-2
[54] Omrani, H., Emrouznejad, A., Shamsi, M., & Fahimi, P. (2022). Evaluation of insurance companies considering uncertainty: A multi-objective network data envelopment analysis model with negative data and undesirable outputs. *Socio-economic Planning Sciences*, *82*, 101306. DOI: 10.1016/j.seps.2022.101306
[55] Ortynski, K., & Woloszyn, J. (2022). Structure of technical efficiency of insurers in the life insurance industry in Poland. *Central European Review of Economics & Finance*, *39*(4), 24–38. DOI: 10.24136/ceref.2022.015
[56] Pavic Kramaric, T., Pervan, M., & Curak, M. (2022). Determinants of Croatian non-life insurance companies' efficiency. *Croatian Operational Research Review*, *13*(2), 149–160.
[57] Peng, N., Guo, H., Wu, Y., & Liu, P. (2023). Research on the operational efficiency of basic medical insurance for urban employees in China–Based on three-stage DEA model. *Risk Management and Healthcare Policy*, 2783–2803.
[58] Pervan, M., Curak, M., & Pavic Kramaric, T. (2021a). Has accession to the European Union affected the efficiency of Croatian insurance companies? *Zagreb International Review of Economics & Business*, *24*(1), 67–98. DOI: 10.17535/crorr.2022.0011
[59] Pervan, M., Kramaric, T. P., & Curak, M. (2021b). A comparative analysis of the efficiency of life and non-life sectors in selected CEE countries. *Ekonomski vjesnik/Econviews - Review of Contemporary Business, Entrepreneurship and Economic Issues*, *34*(2), 279–290. DOI: 10.51680/ev.34.2.3
[60] Qu, S., Feng, C., Jiang, S., Wei, J., & Xu, Y. (2022). Data-driven robust DEA models for measuring operational efficiency of endowment insurance system of different provinces in China. *Sustainability*, *14*(16), 9954. DOI: 10.3390/su14169954
[61] Reyna, A. M., Fuentes, H. J., & Nunez, J. A. (2021). Response of Mexican life and non-life insurers to the low interest rate environment. *The Geneva Papers on Risk and Insurance: Issues and Practice*, *47*(2), 409. DOI: 10.1057/s41288-021-00208-8
[62] Safi, S. K., Dorgham, M. M., & Allaloul, S. A. (2024). Impact of senior management's financial intelligence on the financial performance of banks and insurance companies in the Gaza Strip. *Discover Sustainability*, *5*(1), 84. DOI: 10.1007/s43621-024-00232-3
[63] Sanei, R., Hosseinzadeh Lotfi, F., Fallah, M., & Sobhani, F. M. (2022). An estimation of an acceptable efficiency frontier having an optimum resource management approach, with a combination of the DEA-ANN-GA technique (A case study of branches of an insurance company). *Mathematics*, *10*(23), 4503. DOI: 10.3390/math10234503
[64] Sang, T. M., & Hung, N. T. (2024). Dynamic competitiveness, firm performance and the regulatory role of government policies in Industry 5.0. *Discover Sustainability*, *5*(1), 1–21. DOI: 10.1007/s43621-024-00770-w

[65] Sasidharan, S., Ranjith, V. K., & Prabhuram, S. (2020). Micro-and macro-level factors determining financial performance of UAE insurance companies. *The Journal of Asian Finance, Economics and Business*, *7*(12), 909–917. DOI: 10.13106/jafeb.2020.vol7.no12.909
[66] Savic, G., Martic, M., & Popovic, M. (2022). Uvod u analitiku performansi: Analiza obavljanja podataka. Beograd: Fakultet organizacionih nauka.
[67] Shetty, A., & Basri, S. (2020). Assessing the technical efficiency of traditional and corporate agents in Indian life insurance industry: Slack-based data envelopment analysis approach. *Global Business Review*, *21*(2), 490–506. DOI: 10.1177/0972150917749722
[68] Shieh, H. S., Li, Y., Hu, J. L., & Ang, Y. Z. (2022). A comparison of efficiency of life insurance companies in Mainland China and Taiwan using bootstrapped truncated regression approach. *Cogent Economics & Finance*, *10*(1), 2043571. DOI: 10.1080/23322039.2022.2043571
[69] Siddiqui, S. A. (2021). Total factor productivity growth of Indian life insurance companies: A Malmquist approach. *Indian Journal of Economics and Development*, *17*(1), 232–236. DOI: 10.35716/IJED/20058
[70] Siddiqui, S. A. (2022). How efficient is Indian health insurance sector: An SBM-DEA study. *Managerial and Decision Economics*, *43*(4), 950–962. DOI:10.1002/mde.3430
[71] Siddiqui, S. A., & Shaddady, A. (2023). How profit efficient is Indian life insurance industry: A DEA study. *SAGE Open*, *13*(4). DOI:10.1177/21582440231211686
[72] Sinha, R. P., Cvetkovska, V., & Peovski, F. (2022). Efficiency of Indian General Insurance Companies: A Convex Nonparametric Least Squares Approach. *Croatian Operational Research Review*, *13*(2), 187–201. DOI: 10.17535/crorr.2022.0014
[73] Suarez-Fernandez, S., Quiroga-Garcia, R., & Manzano-Perez, I. (2021). A comparison of DEA and SFA approaches: Application to the US non-life insurance market. *Applied Economics Journal*, *28*(2), 107–127.
[74] Tasci, M. Z. (2024). Multidimensional performance evaluation using the hybrid MCDM method: A case study in the Turkish non-life insurance sector. *Journal of Mehmet Akif Ersoy University Economics and Administrative Sciences Faculty*, *11*(2), 854–883. DOI: 10.30798/makuiibf.1439172
[75] Trinh, L.D. (2024). Determinants of efficiency of non-life insurance companies: Evidence from Vietnam. *Financial and Credit Activity: Problems of Theory and Practice*, *6*(59), 223–233. DOI: 10.55643/fcaptp.6.59.2024.4551
[76] Tunay, N., & Tunay, K. B. (2023). Turkiye'de enflasyonun sigorta þirketlerinin performansýna i prim proizvodnji. *Ekonomi Politika ve Finans Arastýrmalarý Dergisi*, *8*(1), 59–82. DOI: 10.30784/epfad.1245708
[77] Uckar, D., & Petrovic, D. (2022). Ucinkovitost osiguravajucih drustava u Hrvatskoj. *Ekonomska misao i praksa*, *31*(1), 49–79. DOI: 10.17818/EMIP/2022/1.3
[78] Ulansari, D. R., & Septiarini, D. F. (2020). A comparative study of the efficiency of conventional and Sharia insurance in Indonesia. *Jurnal Keuangan dan Perbankan*, *24*(2), 202–213. DOI: 10.26905/jkdp.v24i2.3165
[79] Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. DOI: 10.1007/s11192-009-0146-3
[80] Vintila, A., Trucmel, I. M., & Roman, M. D. (2022). Measuring and analyzing the efficiency of firms in the insurance industry using DEA techniques. *Journal of Social and Economic Statistics*, *11*(1–2), 59–83. DOI: 10.2478/jses-2022-0004
[81] Vurur, S., & Ozdemir, L. (2024). Comparison of efficiency levels of Turkish insurance companies with VZA Malmquist total factor efficiency analysis. In *Cross-Disciplinary Impacts on Insurance Law: ESG Concerns, Financial and Technological Innovation* (pp. 127–145). Cham: Springer Nature Switzerland. DOI: 10.1007/978-3-031-38526-1_6
[82] Worthington, A. C., & Nguyen, L. (2024). COVID-19 and efficiency, technology and productivity change in Australian private health insurance funds. *Economic Papers: A Journal of Applied Economics and Policy*, *43*(2), 169–183. DOI: 10.1111/1759-3441.12412
[83] Xie, Q., Zhao, M., Li, R., Li, W., Zheng, X., Li, Y., ... & Wang, F. Y. (2023). Efficiency evaluation of insurance companies from multiperiod perspective. *IEEE Transactions on Computational Social Systems*, *11*(2), 2656–2674. DOI: 10.1109/TCSS.2023.3304906
[84] Xiong, Y. (2022). Operational efficiency evaluation of urban and rural residents' basic pension insurance system by utilizing a picture fuzzy TOPSIS method based on the cumulative prospect theory. *Frontiers in Public Health*, *10*, 1009207. DOI: 10.3389/fpubh.2022.1009207
[85] Xue, Z., & Ma, Z. (2022). Performance evaluation of China's basic pension insurance based on a three-stage superefficient SBM-DEA model. *Discrete Dynamics in Nature and Society*, *2022*(1). DOI: 10.1155/2022/2429927
[86] Yang, S. W., Chu, K. C., & Kreng, V. B. (2021). The impact of global budgeting on the efficiency of healthcare under a single-payer system in Taiwan. *International Journal of Environmental Research and Public Health*, *18*(20), 10983. DOI: 10.3390/ijerph182010983
[87] Ye, M., Yu, M., & Liu, Z. (2022). Evaluation of operational efficiency of urban employees' endowment insurance. *International Journal of Mathematics Trends and Technology (IJMTT)*, *68*. DOI: 10.14445/22315373/IJMTT-V68I11P504

[88] Zhang, H., Li, E. Y., Jiang, J., Fu, W., Peng, S., & Zhan, S. (2023). Resilience of operational performance in China's insurance companies: A dynamic data envelopment analysis. *IEEE Access*, *11*, 112502–112514. DOI: 10.1109/ACCESS.2023.3323587

[89] Zhao, T., Pei, R., & Pan, J. (2021). The evolution and determinants of Chinese property insurance companies' profitability: A DEA-based perspective. *Journal of Management Science and Engineering*, *6*(4), 449–466. DOI: 10.1016/j.jmse.2021.09.005

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