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Corporate Governance and Financial Fraud in ASEAN: A Bibliometric Roadmap for Future Research

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Abstract
Corporate governance and financial statement fraud have increasingly attracted scholarly and regulatory attention in the ASEAN region. This focus aligns with more frequent accounting manipulation and rising demands for transparency. Although literature on this topic is expanding, comprehensive quantitative reviews remain scarce. This study aims to present an updated mapping of the literature on corporate governance and financial statement fraud. It compiles 269 articles published between 2005 and 2024 from the Scopus database. This study employs bibliometric methods, including VOSviewer and the R-Bibliometrix (Biblioshiny) package, to examine productivity, collaboration networks, citation analysis, co-citation analysis, and thematic evolution. The findings identify leading journals, authors, universities, and countries, with Malaysia and Indonesia as dominant contributors. Thematic analysis highlights earnings management as the key issue linking various research streams. Governance mechanisms such as audit committees, audit quality, and ownership structures follow. This study maps the intellectual structure of the literature using co-citation networks and outlines future research directions through thematic maps and the evolution of keywords. It offers the most recent synthesis of the literature, fills gaps in previous reviews, and points to a forward-looking agenda. The agenda encourages the exploration of other ASEAN contexts, the integration of non-traditional issues such as sustainability, and increased cross-country collaborations.

Keywords: Corporate Governance, Financial Statement Fraud, Earnings Management, Bibliometric, ASEAN

1. Introduction

The integrity of global capital markets depends on investor trust in the financial information presented by companies. However, this trust remains consistently threatened by financial statement fraud, a destructive phenomenon that generates massive financial losses, damages corporate reputation, and destabilizes economies (ALShanti et al., 2024). Large-scale accounting scandals, such as Enron, WorldCom, and Wirecard, demonstrate that weak corporate governance functions as a primary driver of financial statement manipulation, resulting in systemic harm (Cressey, 1953; Rahayu et al., 2024). This phenomenon underscores the urgency of understanding both the drivers and deterrents of fraud across diverse economic contexts, including the dynamic ASEAN region. In response to this crisis of confidence, pressures from regulators, investors, and the public demand stronger

accountability and greater transparency. These pressures stimulate waves of global regulatory reforms aimed at strengthening oversight and restoring market confidence. Within the regional context, ASEAN countries confront unique challenges in which rapid economic growth is often not matched by stronger monitoring mechanisms. As a result, the risk of manipulative practices such as earnings management remains significant, particularly in the banking, manufacturing, and energy sectors (Mujennah & Narsa, 2024; Supriatiningsih et al., 2024).

Amid these challenges, corporate governance emerges as a fundamental safeguard mechanism. Strong governance encompasses board independence, audit committee effectiveness, and ownership transparency, which are considered primary deterrents to managerial opportunism (Mlawu et al., 2023). In developing economies such as those in ASEAN, where investor protection institutions may not be as robust as in advanced economies, the role of internal governance mechanisms becomes increasingly critical (Gokhale & Pillai, 2024). However, the effectiveness of these mechanisms varies; for example, studies indicate that audit committees play a significant role in constraining earnings manipulation, while the influence of independent boards shows mixed results (Putra, 2023; Rahayu et al., 2024). International standards, such as the OECD Principles, and regional initiatives, including the ASEAN Corporate Governance Scorecard (ACGS), further reinforce the importance of good governance and promote the harmonization of practices across the region (Asian Development Bank, 2019). These initiatives emphasize that fraud prevention is not only an internal corporate concern but also a matter of regional market stability. This linkage has driven an exceptional surge of research interest over the past two decades, with scholars increasingly examining governance theories within the unique institutional and cultural contexts of Southeast Asia (Bui, 2024). As a result, thousands of publications now appear across multiple journals. However, this explosion of information also brings about new challenges: the existing literature remains highly fragmented. Notably, many studies focus on single-country contexts, such as Indonesia or Malaysia (Khuong et al., 2024; Supriatiningsih et al., 2024), and employ limited cross-sectional approaches, applying varying definitions of fraud. Moreover, traditional literature reviews often employ a narrative style, which can introduce subjectivity and fail to provide a comprehensive quantitative perspective. Consequently, this fragmentation complicates efforts to develop a coherent understanding of the ASEAN context and constrains the formulation of integrated, evidence-based policy recommendations.

Bibliometric analysis is an objective, systematic approach for mapping a field's intellectual landscape (Aria & Cuccurullo, 2017; Ratna & Junaidi, 2024). Visualization techniques, such as science mapping, reveal trends, dominant themes, and conceptual structures that are difficult to identify through conventional reviews. Several bibliometric studies examine related topics, such as audit committees and audit quality, but most focus on a global perspective. No study has yet mapped the literature on corporate governance and financial statement fraud in the ASEAN region. This study fills that gap by conducting a comprehensive bibliometric analysis of the literature on corporate governance and financial statement fraud in ASEAN countries. It draws from 269 articles in the Scopus database, covering the period from 2005 to 2024. This study maps the evolution, intellectual structure, and future directions of this research domain. This review expands the existing literature on corporate governance and financial statement fraud, and proposes several research questions for further investigation.

RQ1. What are the publication trends on corporate governance and financial statement fraud in ASEAN in terms of time, journals, authors, countries, and institutional affiliations?
RQ2. What are the most influential studies and research themes in this domain?
RQ3. How does the intellectual structure of research on corporate governance and financial statement fraud evolve, and what are the current research trends?
RQ4. What gaps and areas for future research?

This study makes a significant contribution by presenting the first comprehensive bibliometric mapping of the intersection between corporate governance and fraud, specifically within the ASEAN region, over 20 years. In addition, it provides a clear roadmap for future researchers by identifying both saturated areas and open research gaps. This article organizes its content into several sections. Section 3 presents and discusses the findings of the bibliometric analysis. Finally, section five presents the conclusion, highlights the study’s limitations, and proposes directions for future research.

2. Method

This study applies quantitative bibliometric analysis by utilizing literature data from the Scopus database. We chose Scopus for several key advantages: its comprehensive coverage of major publishers, its strict indexing requirements that ensure publication quality, and its provision of citation analysis and advanced filtering features, which are highly suitable for bibliometric reviews (Abhilash et al., 2023). Additionally, we selected Scopus because it works well with analytical software such as VOSviewer and RStudio (Dervis, 2019). We conducted the methodological process in three systematic stages: (1) literature data acquisition, (2) data processing, and (3) statistical analysis and mapping.

2.1 Literature Data Acquisition

The data acquisition process in this study adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, which comprises four main stages: identification, screening, eligibility assessment, and inclusion, as illustrated in Figure 1. Three independent reviewers validate this process. Literature searching is conducted exclusively through the Scopus database by employing a combination of relevant keywords. The search strategy applies the following keywords for the term corporate governance: ("corporate governance" OR "board of directors" OR "board independence" OR "CEO duality" OR "audit committee" OR "internal control" OR "ownership structure" OR "managerial ownership" OR "external audit" OR "audit quality" OR "auditor independence" OR "institutional investors"). The search strategy employs the following keywords for the term "financial statement fraud": ("financial statement fraud" OR "fraudulent financial reporting" OR "accounting fraud" OR "corporate fraud" OR "earnings management" OR "accounting manipulation" OR "financial misstatement" OR "financial misrepresentation"). Several search operators guide the search process to ensure that relevant results are obtained. First, quotation marks ("…") identify exact phrases, for example, "financial statement fraud" retrieves only articles containing the precise phrase. Second, the OR operator retrieves articles containing at least one of the specified terms. Third, the AND operator ensures that both sets of terms appear simultaneously in the search results.

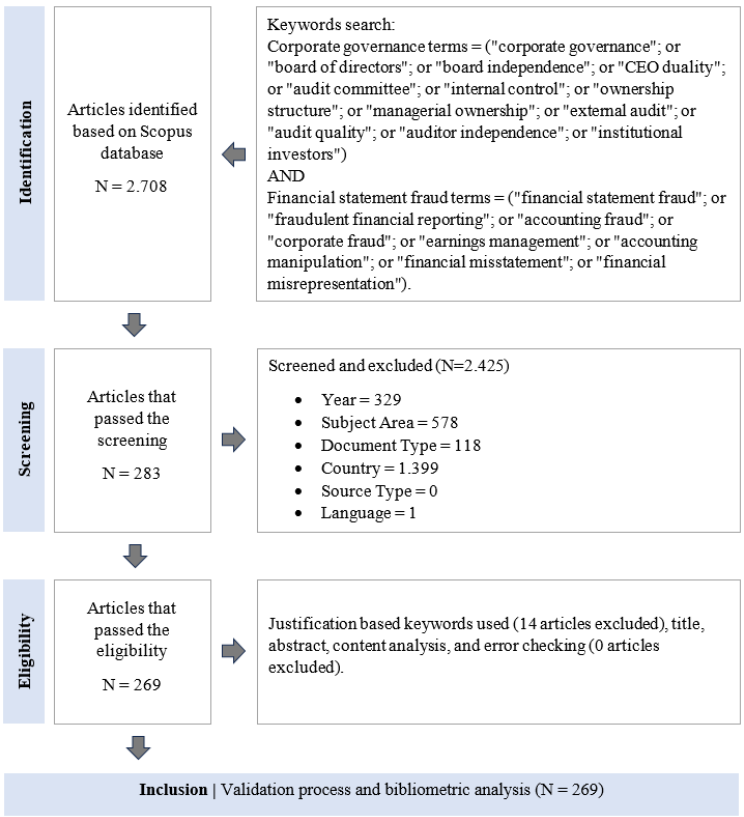

Figure 1. Articles Inclusion/Exclusion Flowchart
Source: Authors Compilation, 2025

The initial search with predetermined keywords generates 2,708 articles. A screening stage then applies a series of specific criteria. These criteria include the publication year range from 2005 to 2024 to capture the evolution of research over two decades. The choice of 2005 as the starting year reflects the post-Sarbanes-Oxley Act (SOX) era, when global corporate governance reforms began to be widely adopted, stimulating a wave of new research across various regions, including the ASEAN region. Further criteria encompass the fields of Business, Management, and Accounting to ensure disciplinary relevance, as well as affiliations with ASEAN countries to analyze trends within a unique regional context. The study excludes publications in the form of books, book chapters, and conference proceedings because they generally involve less rigorous peer-review processes and provide limited theoretical contributions (Tautiva et al., 2024). Accordingly, this study only includes journal publications in the form of articles and reviews. A restriction to English-language articles is applied to avoid potential bias that may arise from incorporating multiple languages. The screening process eliminates 2,425 articles that do not meet the criteria.

The next step is the eligibility stage, in which 283 remaining articles undergo further examination for relevance. At this stage, the assessment ensures the completeness and suitability of bibliometric data for analysis using RStudio. Quality criteria, such as journal rankings, do not serve as exclusion parameters, as the aim of this study is to provide a comprehensive overview of the entire body of literature. The quality of the articles is assured by relying on the reputation and indexing standards of the Scopus database. As a result, this stage eliminates 14 articles that do not meet data eligibility requirements. The final stage involves inclusion, where 269 articles are validated and confirmed as eligible for further analysis. The entire process, from identification to inclusion, is validated by three independent reviewers to ensure the reliability and validity of the dataset, as illustrated in Figure 1. The validation guarantees a structured analysis applicable to future surveys, and the researchers conduct the final search query (September 2025): (TITLE-ABS-KEY ("corporate governance") OR TITLE-ABS-KEY ("board of directors") OR TITLE-ABS-KEY ("board independence") OR TITLE-ABS-KEY ("CEO duality") OR TITLE-ABS-KEY ("audit committee") OR TITLE-ABS-KEY ("internal control") OR TITLE-ABS-KEY ("ownership structure") OR TITLE-ABS-KEY ("managerial ownership") OR TITLE-ABS-KEY ("external audit") OR TITLE-ABS-KEY ("audit quality") OR TITLE-ABS-KEY ("auditor independence") OR TITLE-ABS-KEY ("institutional investors") AND TITLE-ABS-KEY ("financial statement fraud") OR TITLE-ABS-KEY ("fraudulent financial reporting") OR TITLE-ABS-KEY ("accounting fraud") OR TITLE-ABS-KEY ("corporate fraud") OR TITLE-ABS-KEY ("earnings management") OR TITLE-ABS-KEY ("accounting manipulation") OR TITLE-ABS-KEY ("financial misstatement") OR TITLE-ABS-KEY ("financial misrepresentation")) AND PUBYEAR > 2004 AND PUBYEAR < 2025 AND (LIMIT-TO (AFFILCOUNTRY , "Brunei Darussalam") OR LIMIT-TO (AFFILCOUNTRY , "Indonesia") OR LIMIT-TO (AFFILCOUNTRY , "Malaysia") OR LIMIT-TO (AFFILCOUNTRY , "Singapore") OR LIMIT-TO (AFFILCOUNTRY , "Thailand") OR LIMIT-TO (AFFILCOUNTRY , "Viet Nam")) AND (LIMIT-TO (SUBJAREA , "BUSI")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (EXCLUDE (EXACTKEYWORD , "China") OR EXCLUDE (EXACTKEYWORD , "Jordan") OR EXCLUDE (EXACTKEYWORD , "Nigeria") OR EXCLUDE (EXACTKEYWORD , "Oman"))).

2.2 Data Processing

The study conducts data analysis using bibliometric methods on 269 selected articles. The process employs two primary software tools, VOSviewer and the R-Bibliometrix package (Biblioshiny) (Aria & Cuccurullo, 2017). The combination of these tools enables a comprehensive execution of both performance analysis and science mapping. Performance analysis, conducted primarily through Biblioshiny, encompasses the evaluation of annual scientific productivity, the identification of influential authors, institutions, and countries, and the assessment of sources to determine the journals with the most significant contributions. In addition, co-authorship analysis maps the social structure and collaboration networks among researchers.

Science mapping, facilitated by VOSviewer and Biblioshiny, focuses on understanding the conceptual and intellectual structure of the field. Keyword co-occurrence analysis identifies the core research themes, under the assumption that the co-appearance of specific terms reflects conceptual relationships between them (Zupic &

Cater, 2015). This technique effectively reveals research trends, collaboration patterns, and the thematic evolution of scholarly work across disciplines (Behl et al., 2022; Sharifani & Amini, 2023), while also providing direction for future research development. Furthermore, citation and co-citation analyses specifically uncover the intellectual structure of the field and identify foundational works that serve as its theoretical pillars.

2.3 Data Statistics, Mapping, and Finding Review

Descriptive statistics and network visualizations, presented in the form of tables and figures, provide an analysis of keyword co-occurrence and co-authorship. These representations aim to map the evolution of research, uncover the intellectual structure, and highlight the significant contributions within the literature. The findings are subsequently interpreted in depth to address each research question and to formulate relevant recommendations for future research agendas.

3. Results and Discussion

3.1 General Characteristics of Literature

Table 1: Summary of the Key Characteristics of the 269 Articles Analyzed

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2006:2024
Sources (Journals, Books, etc)	114
Documents	269
Annual Growth Rate %	17.94
Document Average Age	5.77
Average citations per doc	25.02
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	18
Author's Keywords (DE)	574
AUTHORS	
Authors	647
Authors of single-authored docs	19
AUTHORS COLLABORATION	
Single-authored docs	20
Co-Authors per Doc	3.04
International co-authorships %	35.32
DOCUMENT TYPES	
article	264
review	5

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

The bibliometric analysis of 269 articles from 114 publication sources, spanning the period from 2006 to 2024, is presented in Table 1. The literature on corporate governance and financial statement fraud shows an average annual growth rate of 17.94%, with a relatively young average document age of 5.77 years. This pattern suggests that corporate governance and financial statement fraud are emerging areas of concern. The average of 25.02 citations per article demonstrates that publications in this area not only grow quantitatively but also attract substantial scholarly attention in the global literature. In terms of authorship, 647 contributors are identified, with the majority of studies conducted collaboratively (only 19 articles are single-authored), and 35.32% involve international collaboration. Several noteworthy patterns emerge from this descriptive analysis. First, the sharp increase in

publications after 2018 reflects growing attention from regulators and capital markets in ASEAN toward governance practices, particularly in the aftermath of various regional accounting scandals. Second, the relatively high rate of international collaboration suggests that governance and fraud in ASEAN are increasingly capturing global attention, although research activity remains concentrated in specific countries. Third, the relatively young age of the literature suggests that the field has not yet reached saturation, thereby leaving ample opportunities for exploring new themes. The implications of these findings emphasize that the ASEAN literature on governance and fraud is in a rapid growth phase, but remains fragmented. Future researchers, therefore, need to leverage this momentum to foster more balanced cross-country collaboration within ASEAN and expand research themes beyond dominant issues such as earnings management. Such efforts are crucial for building a body of literature that is more representative of the regional context while simultaneously strengthening the theoretical and practical contributions of governance research at the global level.

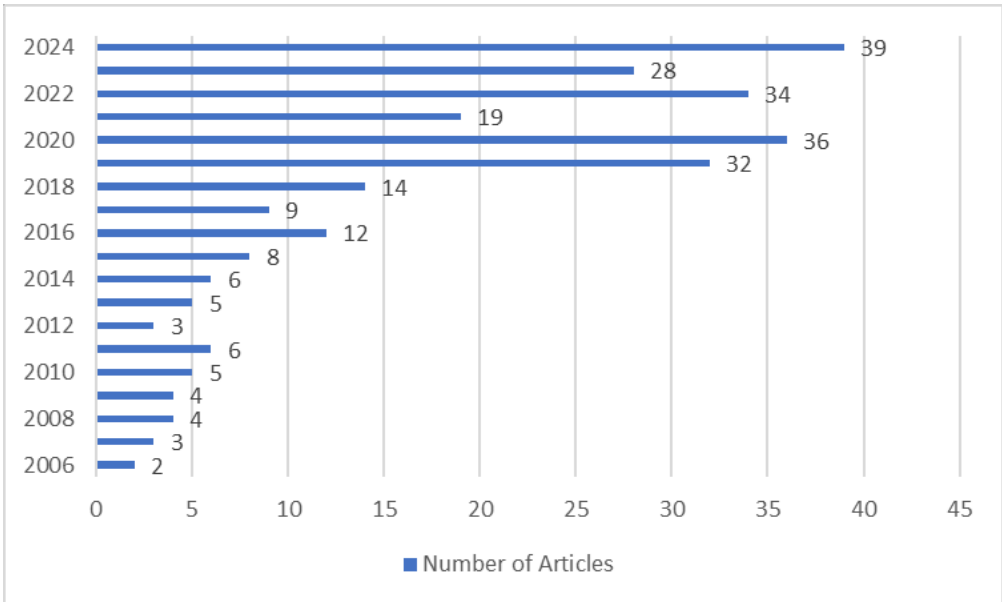

Figure 2: Document by Year of Publication
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 2 illustrates the annual distribution of publications on corporate governance and financial statement fraud in ASEAN countries. Research on this topic began in 2006 with a relatively low output of only two articles. Subsequent developments indicate a gradual increase until 2014, with the number of publications ranging from three to nine per year, signaling a growing academic interest in governance and financial reporting integrity within the region. Since 2016, the number of publications has risen more consistently, reaching 12 articles in 2016 and continuing to grow, albeit with some fluctuations. A significant surge emerges in 2018, with 14 publications, and this trend continues in the following years, particularly in the years that followed, with publication numbers surging significantly in 2019, 2020, and 2022, each recording more than 30 articles. The peak occurs in 2024 with 39 articles, the highest level throughout the study period. This upward trend aligns with the increasing emphasis on good corporate governance as a mechanism to prevent fraud and with the strengthening of accounting and auditing regulations across ASEAN countries. Furthermore, issues such as earnings management, the role of boards of directors, family ownership, and the effectiveness of audit committees are prominent in the literature, driving scholarly attention. Regional financial scandals also stimulate the rising volume of research and reinforce the urgency of investigating the link between governance and financial statement fraud.

3.1.1 General Characteristics of Sources

Table 2 presents the performance of journals that serve as the leading publication outlets for research on corporate governance and financial statement fraud in the ASEAN region. In total, more than 20 journals publish significant contributions on this topic, reflecting the wide distribution of literature across diverse academic outlets in accounting, finance, and management. Cogent Business and Management ranks highest with 16 articles and 203

citations, underscoring its central role as a platform for disseminating governance and fraud research in ASEAN. Corporate Ownership and Control, as well as the Journal of Asian Finance, Economics and Business, each publish nine articles, with 59 and 133 citations, respectively, indicating their popularity among scholars in this field. In terms of impact, the Asian Review of Accounting and Corporate Governance (Bingley) records the highest citations, 380 and 293, respectively, despite publishing only six articles, which highlights the strong influence and readership of articles featured in these journals. The International Journal of Accounting and Information Management also demonstrates strong visibility, with four articles that have accumulated 211 citations, confirming its position as an influential outlet in accounting and governance studies. Furthermore, regional journals such as Jurnal Pengurusan (Malaysia) and Management and Accounting Review make significant contributions to the development of literature in Southeast Asia, despite their citation counts remaining relatively lower compared to highly ranked international journals. This balance between local and global publication outlets illustrates how both spheres contribute to advancing the discourse on governance and fraud within the ASEAN context.

Table 2: Most Relevant Journals

Journals	Articles	Total Citations
Cogent Business and Management	16	203
Corporate Ownership and Control	9	59
Journal of Asian Finance, Economics and Business	9	133
International Journal of Financial Research	8	65
International Journal of Scientific and Technology Research	7	25
Academy of Accounting and Financial Studies Journal	6	94
Asian Economic and Financial Review	6	64
Asian Review of Accounting	6	380
Corporate Governance (Bingley)	6	293
International Journal of Economics and Management	6	185
Jurnal Pengurusan	6	54
Afro-Asian Journal of Finance and Accounting	5	18
Asian Journal of Accounting Research	5	189
Journal of Accounting in Emerging Economies	5	138
Management and Accounting Review	5	14
Quality - Access to Success	5	6
Asian Journal of Business and Accounting	4	141
International Journal of Accounting and Information Management	4	211
International Journal of Business and Society	4	27
Journal of Risk and Financial Management	4	23

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

3.1.2 General Characteristics of Authors – Most Active Countries

The analysis of country-level productivity in Table 3 reveals that Malaysia (183 publications) and Indonesia (173 publications) are the leading contributors to the literature on corporate governance and financial statement fraud in the ASEAN region. The high publication volume underscores the dominance of these two countries in producing research on the topic, far surpassing other ASEAN members such as Singapore (21 publications) and Thailand (4 publications). Citation analysis in Figure 3 further strengthens this observation. Malaysia records 2,434 citations, while Indonesia accumulates 1,113 citations, positioning both countries not only as the most productive but also as the most influential contributors in the global literature. Interestingly, Hong Kong emerges as one of the countries with the highest citation counts (1,119 citations), despite not being among the most prolific publishers, which suggests that the quality of its publications generates a significant scientific impact. Other countries, such as Australia (603 citations) and Singapore (407 citations), also demonstrate a balance between productivity and impact, although their quantitative contributions remain relatively lower than those of Malaysia and Indonesia.

Conversely, Thailand records only four publications with 40 citations, reflecting the limited academic contribution of this country to the discourse on governance and financial statement fraud.

Table 3: Most Productive Countries

Countries	Publications	Countries	Publications
Malaysia	183	Nigeria	7
Indonesia	173	India	4
Australia	22	New Zealand	4
Singapore	21	Pakistan	4
USA	14	Thailand	4
Saudi Arabia	13	Bahrain	3
Yemen	13	Oman	3
UK	12	United Arab Emirates	3
Jordan	9	Bangladesh	2
China	8	Egypt	2

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

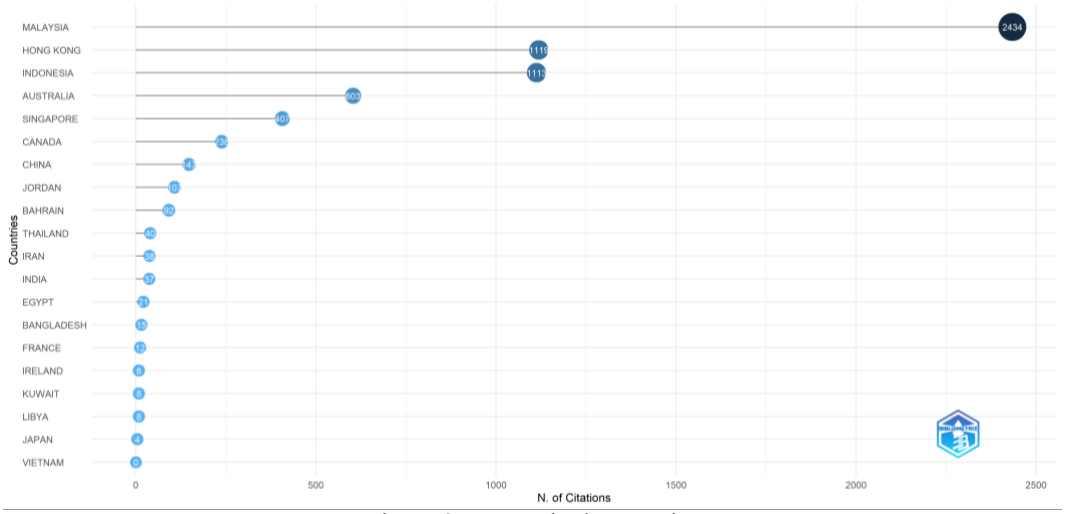

Figure 3: Most Cited Countries

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

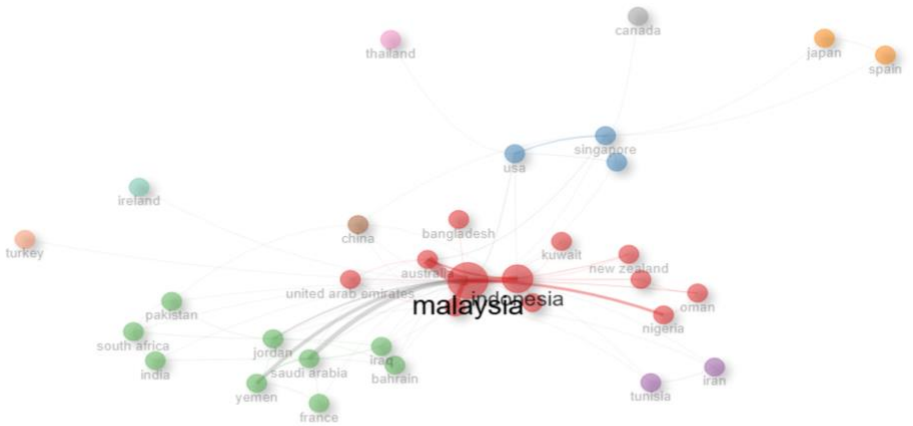

Figure 4: Country Collaboration Networks

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 4 visualizes the international collaboration network in corporate governance and financial statement fraud research. Malaysia and Indonesia emerge as central hubs in the network, as reflected by the dominant node sizes and their extensive connectivity with other countries. Research collaborations extend beyond the ASEAN region (e.g., with Singapore and Thailand) to include Australia, Europe, the Middle East, and the United States. The network forms several regional clusters, with the Malaysia–Indonesia collaboration serving as a key bridge across these clusters. Connections with countries such as Australia and Singapore appear stronger compared to those with regions like Africa or the Middle East, which display more limited links. This pattern highlights that, while the research focus primarily lies within the ASEAN context, contributions from global scholars provide an essential comparative dimension. Ultimately, the vibrancy of these international collaborations not only enriches the regional discourse but also propels ASEAN scholarship to a position of greater influence and relevance in the global academic conversation on governance and fraud.

3.1.3 General Characteristics of Authors – Most Active Universities

Table 4: Top Productive Universities

Affiliation	Articles
Universiti Utara Malaysia	37
Universiti Teknologi Mara	36
Universitas Diponegoro	13
Universiti Putra Malaysia	12
Multimedia University	11
Universitas Sultan Ageng Tirtayasa	11
Universitas Airlangga	10
Universitas Negeri Semarang	9
Universitas Indonesia	8
Universiti Malaya	7
Universiti Sains Malaysia	7
Bina Nusantara University	6
Hodeida University	6
International Islamic University Malaysia	6
Nanyang Technological University	6
National Economics University Hanoi	6
Singapore Management University	6
Universitas Dian Nuswantoro	5
Universitas Sriwijaya	5
Universiti Kebangsaan Malaysia	5

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Table 4 highlights the universities with the highest research productivity in the areas of corporate governance and financial statement fraud. Universiti Utara Malaysia occupies the top position with 37 articles, followed closely by Universiti Teknologi Mara with 36 articles. The subsequent ranks include Universitas Diponegoro (13 articles), Universiti Putra Malaysia (12 articles), and Universitas Sultan Ageng Tirtayasa (11 articles). Meanwhile, several other institutions, such as Universitas Airlangga, Universitas Negeri Semarang, Universitas Indonesia, and Universiti Malaya, consistently contribute, although with a smaller number of publications. This pattern indicates that research productivity is predominantly concentrated in Malaysia and Indonesia, two ASEAN countries that represent the most active contributors to the literature, as also reflected in the country-level distribution of publications. In addition, several universities outside ASEAN, including Hodeidah University (Yemen), Nanyang Technological University (Singapore), and National Economics University, Hanoi (Vietnam), appear in the list of productive institutions, although their contributions remain relatively limited.

Figure 5 presents the mapping of inter-university collaborations. Universiti Utara Malaysia and Universiti Teknologi Mara serve as central hubs within the network, demonstrating extensive affiliations with both regional and international institutions. Distinct clusters of collaboration are evident among Indonesian universities, such as Universitas Diponegoro, Universitas Gadjah Mada, and Universitas Dian Nuswantoro, which exhibit close interconnections with one another and with their Malaysian counterparts. These collaborative networks have a profound impact on research on governance and fraud in ASEAN, facilitating the exchange of ideas, methodologies, and scholarly perspectives. With Malaysia and Indonesia serving as principal research centers, and the participation of international universities, the field advances through robust collaboration while simultaneously enhancing ASEAN's representation in global literature.

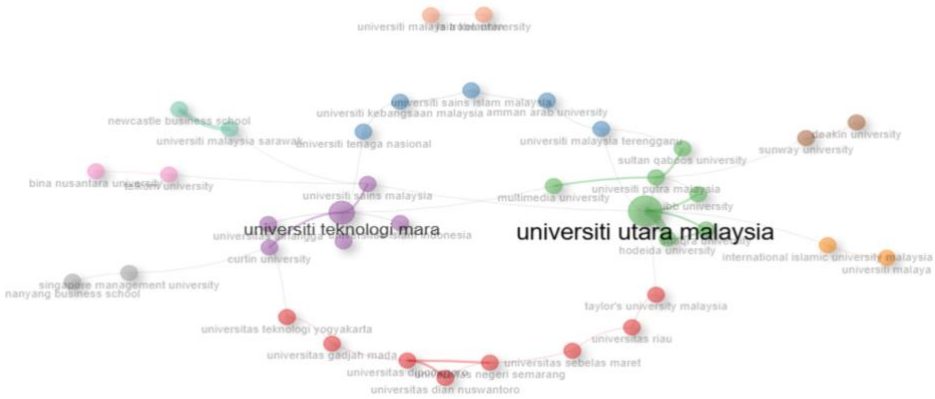

Figure 5: Universities Collaboration Networks
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

3.1.4 General Characteristics of Authors – Most Active Authors

Table 5 presents the most relevant authors in research on corporate governance and financial statement fraud. Chandren S. A. and Ku Ismail K. N. I. occupy the leading positions, each contributing eight articles, highlighting their prolific publication record. Notably, Ku Ismail K. N. I. records the highest citation count (N = 262) and the highest H-Index (8), indicating both widespread recognition and consistent scholarly impact. Al-Absy M. S. M., with six articles, also demonstrates significant influence through 149 citations and an H-Index of 6, signifying substantial reach and authoritativeness. Other scholars, including Abdul Latif R., Ghozali I., and Pamungkas I. D., contribute regularly, further strengthening the diversity and breadth of research in this field.

Table 5: Most Relevant Authors

Authors	Articles	TC	H-Index
Chandren S. A.	8	175	8
Ku Ismail K. N. I.	8	262	8
Al-Absy M. S. M.	6	149	6
Abdul Latif R.	5	65	4
Ghozali I.	5	50	3
Mohd-Sanusi Z.	5	51	3
Pamungkas I. D.	5	59	3
Ahmad Z. B.	4	8	1
Farooque O. A.	4	166	3
Ghaleb B. A.	4	86	4

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 6 depicts the author collaboration network. The largest nodes, Chandren S. A. and Al-Absy M. S. M., indicate a greater intensity of collaboration compared to other authors. The network separates into distinct, color-coded clusters, each denoting groups of researchers with closely aligned interests. For example, Chandren S. A.

maintains strong ties with Ahmad Z. B. and Abdul Latif R., while another cluster underscores collaboration between Pamungkas I. D. and Ghozali I. This structure demonstrates the integration of Malaysian and Indonesian scholars as pivotal figures in the field's academic discourse. The quantitative data in Table 5 and the collaboration networks shown in Figure 6 demonstrate how key authors shape this research area by combining prolific output with robust cross-country collaboration, thereby enhancing both the volume of publications and the quality of scholarly exchange.

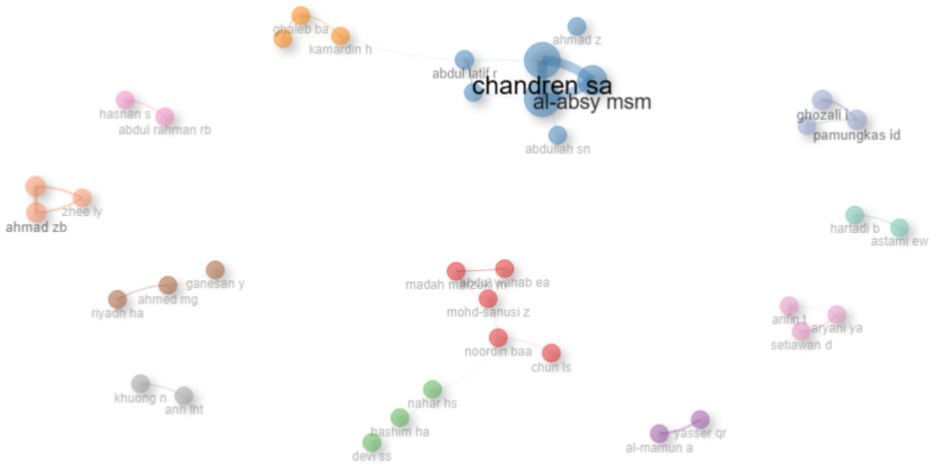

Figure 6: Authors Collaboration Networks
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

3.2 The Influential Studies and Themes of Research

To identify the most influential contributions, Table 6 presents the ten most cited articles in research on corporate governance and financial statement fraud. The most cited work, Jian & Wong (2010), investigates earnings management through related-party transactions in Chinese listed firms, receiving 584 citations. Rahman & Ali (2006) rank second with 455 citations, examining the effectiveness of boards, audit committees, and concentrated ownership in curbing earnings management among Malaysian public companies. Jaggi et al. (2009) contribute 367 citations by analyzing the effectiveness of independent boards in limiting earnings management in Hong Kong firms, reflecting strong scholarly attention to governance issues across countries. Other influential studies include Siregar & Utama (2008), which explores the types of earnings management in Indonesian companies, and Lennox & Pittman (2010), which tests the role of Big Five auditors in detecting accounting manipulation in the United States, each attracting over 230 citations. Several additional articles highlight more specific themes, such as the impact of corporate governance and CSR on financial statement fraud (Mahrani & Soewarno, 2018), board independence reforms (Chen et al., 2015), the role of audit committee characteristics (Saleh et al., 2007), and litigation risk in real earnings management (Huang et al., 2020). Collectively, these ten studies provide a robust conceptual and empirical foundation for subsequent research, particularly in the areas of governance mechanisms, board independence, audit quality, and the role of regulatory environments. Overall, Table 6 demonstrates that the most influential literature consistently emphasizes how governance mechanisms constrain earnings management, whether through board oversight, auditor effectiveness, or regulatory influence. These works establish a critical foundation for advancing research on financial statement fraud across diverse national contexts.

Table 6: Overview of Top-Cited Articles Included in the Analysis by Citations Per Year

ID	Purpose	Subject	Methods	Cited	Reference
1	Investigates earnings propping practices through related-party transactions	Publicly listed firms in China (1998–2002)	OLS regression	584	(Jian & Wong, 2010)
2	Examines the effectiveness of boards of directors, audit committees, and concentrated ownership in mitigating earnings management	97 publicly listed firms in Malaysia (2002–2003)	Regression analysis (Modified Jones Model)	455	(Rahman & Ali, 2006)
3	Tests the effectiveness of independent boards in monitoring earnings management and whether family control moderates this relationship	770 firm-year observations in Hong Kong (1998–2000)	Regression analysis (2SLS and OLS)	367	(Jaggi et al., 2009)
4	Explores the types of earnings management (efficient vs. opportunistic) and the influence of ownership structure, firm size, and corporate governance	144 publicly listed firms in Indonesia (1995–1996 & 1999–2002)	Multiple regression analysis	242	(Siregar & Utama, 2008)
5	Examines whether audits conducted by Big Five firms are associated with lower incidences of accounting fraud	U.S. firms engaged in accounting fraud (1981–2001)	Probit regression	238	(Lennox & Pittman, 2010)
6	Analyze the influence of corporate governance and CSR on financial performance with earnings management as a mediating variable	102 manufacturing firms in Indonesia (2014)	Partial Least Squares (PLS)	175	(Mahrani & Soewarno, 2018)
7	Evaluates the impact of board independence reforms on earnings management	1,587 firms (2000–2005)	Regression analysis (Difference-in-Differences)	168	(Chen et al., 2015)
8	Assesses the effectiveness of audit committee characteristics in constraining earnings management	548 publicly listed firms in Malaysia (2001)	Regression analysis	155	(Saleh et al., 2007)
9	Investigates earnings management in IPO firms and its effect on post-IPO performance	250 IPO firms in Malaysia (1990–2000)	Regression analysis	132	(Ahmad-Zaluki et al., 2011)
10	Examines the effect of litigation risk on real earnings management (REM)	Publicly listed firms in the United States (1995–2003)	Regression analysis (Difference-in-Differences)	131	(Huang et al., 2020)

Source: Authors Compilation, 2025

Figure 7 depicts the thematic development of research on corporate governance and financial statement fraud from 2006 to 2024. In the first period (2006–2009), research focuses on earnings management, with related topics including firm size, ownership structure, and audit committees. This pattern suggests that early studies primarily focused on identifying the key drivers of earnings manipulation. As the focus shifts to the period from 2010 to 2014, research expands to include themes such as audit quality, family ownership, and financial reporting, signalling a greater emphasis on monitoring mechanisms and the impact of family ownership on fraudulent reporting. This trend continues from 2015 to 2019, as the analysis deepens to highlight fraud, financial statement fraud, agency theory, and the contexts of Indonesia and Malaysia. These topics reveal the growing interest in the

ASEAN region and the application of agency theory to fraudulent behavior and governance. Most recently, during the period from 2020 to 2024, a sharper emphasis on board independence, Collins Ntim's influence, fraudulent reporting, and ongoing interest in earnings management have been observed. This progression demonstrates that current research is increasingly centered on governance mechanisms, the independence of boards, and empirical studies of earnings manipulation and fraud. In summary, this thematic trajectory reveals an evolution from broad issues, such as firm size and audit committees, toward more specialized areas, including governance structures, developing country contexts, and board independence in fraud reporting. This progression illustrates the field's theoretical advancement and growing practical relevance both globally and regionally.

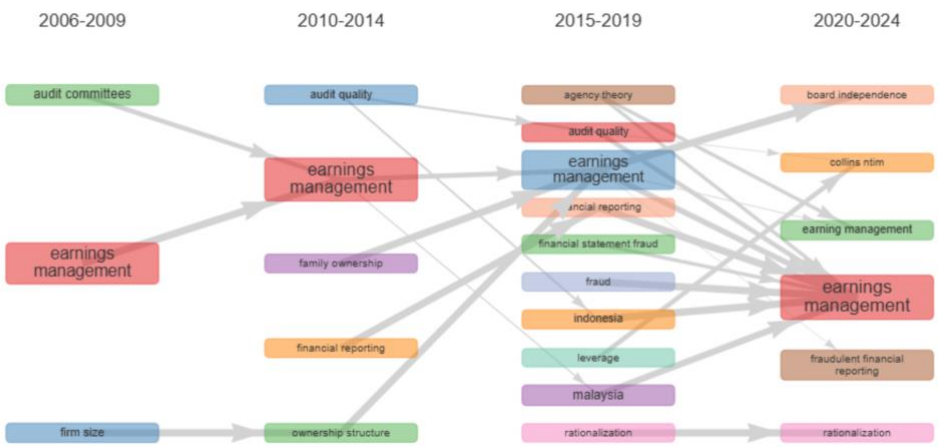

Figure 7: Thematic Evolution
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

3.3 The Intellectual Structure and the Recent Research Trends in Corporate Governance and Financial Statement Fraud Research

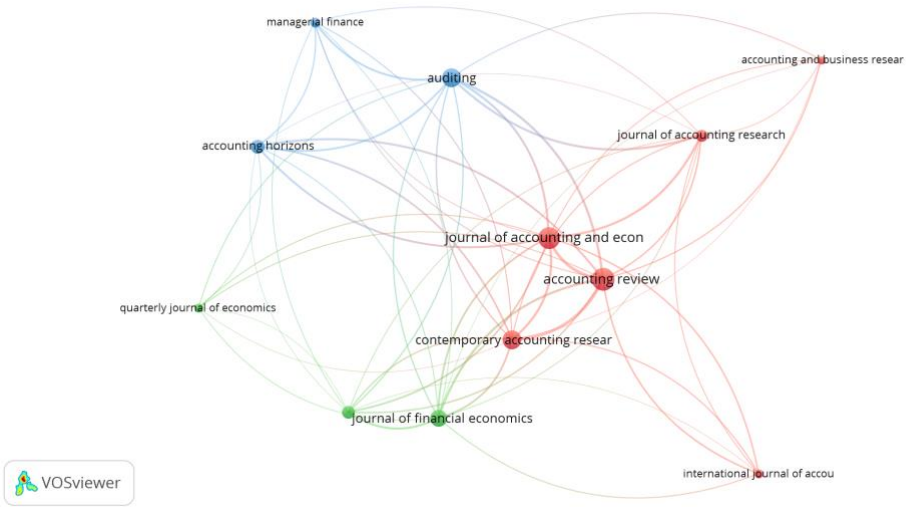

Figure 8: Co-citation Network by References
Source: Processed Using VOSviewer, 2025

Figure 8 presents the results of a co-citation network analysis based on references, using a minimum threshold of 10 citations. Out of a total of 1,626 references cited within the network, 21 articles meet this threshold and form a more distinct co-citation structure. The analysis identifies three main clusters represented by different colors. The first cluster (red) focuses on earnings management and the determinants of financial reporting manipulation,

exemplified by studies such as Beasley (1996), Burgstahler & Dichev (1997), and Bartov et al. (2000). The second cluster (green) emphasizes corporate governance issues related to gender, ownership, and the role of audit committees, as reflected in works such as Rahman & Ali (2006), Abdullah et al. (2016), and Adams (2016). The third cluster (blue) focuses on the intersection of auditing, governance, and reporting quality, as illustrated by contributions such as those of Abbott & Parker (2000) and Agrawal & Chadha (2005). This network underscores the interconnection of prior research on governance and fraud, thereby establishing a solid conceptual foundation for subsequent literature in the field.

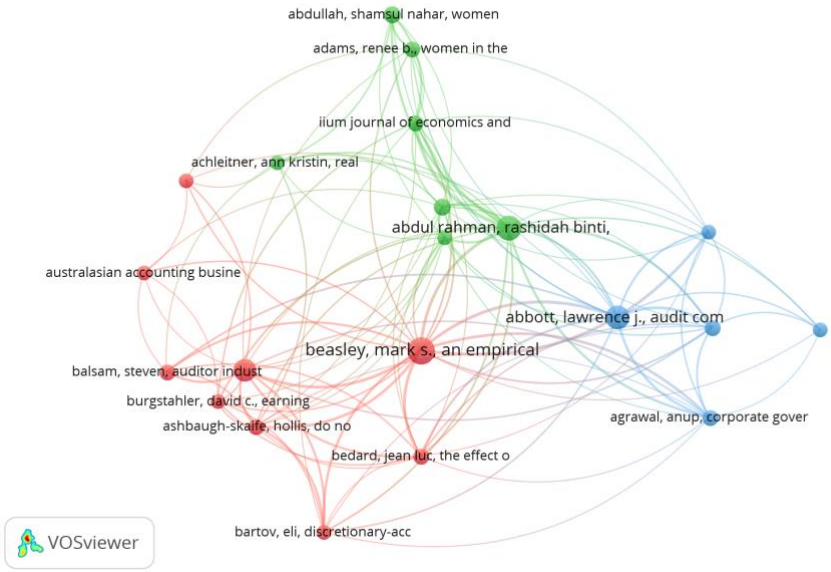

Figure 9: Co-citation Network by Journals
Source: Processed Using VOSviewer, 2025

Figure 9 visualizes the co-citation network by journals. This visualization applies a minimum threshold of 10 citations. Of the 144 cited sources, 12 journals meet this threshold and form the core network. The Journal of Accounting and Economics and The Accounting Review occupy central positions in the field. They have extensive connections to other journals, indicating their dominant influence on the development of governance and financial fraud literature. Contemporary Accounting Research and Journal of Accounting Research also demonstrate high levels of co-citation. This reflects their reputation as primary references in accounting and governance scholarship. The green cluster, represented by the Journal of Financial Economics and the Quarterly Journal of Economics, highlights the contribution of finance scholarship to enriching fraud and governance analysis. The blue cluster, which includes journals such as Auditing and Accounting Horizons, focuses on audit perspectives and reporting practices. This visualization reinforces that research on governance and fraud evolves not only within core accounting literature. It also grows through interdisciplinary contributions, particularly from financial management and auditing.

3.4 Keywords Analysis and Future Directions

The analysis of keyword co-occurrences produces a comprehensive overview of the dominant themes in the literature on corporate governance and financial statement fraud. Table 7 presents the selected keywords according to network parameters, specifically the centrality measures of betweenness, closeness, and PageRank. Betweenness measures how often a keyword bridges distinct groups, while closeness assesses how quickly a keyword connects with all other keywords in the network. PageRank considers both the quantity and strength of a keyword's connections to estimate its overall influence. Collectively, these measures highlight the diverse roles that keywords play within the scholarly network.

Table 7: Keyword Selected for Network Parameters

Node	Cluster	Betweenness	Closeness	PageRank
Earnings Management	1	487,33	0,018	0,193
Corporate Governance	1	373,482	0,018	0,148
Audit Committee	1	21,744	0,013	0,044
Malaysia	1	13,675	0,012	0,048
Board of Directors	1	0	0,011	0,015
Audit Committees	1	0	0,011	0,015
Financial Reporting Quality	1	0,436	0,012	0,018
Fraudulent Financial Reporting	1	0	0,011	0,011
Agency Theory	1	0	0,01	0,008
Corporate Social Responsibility	1	0	0,011	0,01
Earnings Quality	1	0	0,011	0,009
Financial Statement Fraud	1	0	0,01	0,006
Board Independence	1	0	0,01	0,005
Financial Reporting	1	0	0,011	0,011
Leverage	1	0,187	0,011	0,011
Board Characteristics	1	0	0,011	0,008
Firm Size	1	0,1	0,011	0,01
Fraud	1	0	0,01	0,006
Good Corporate Governance	1	0	0,01	0,005
Accounting Fraud	1	0	0,01	0,005
Disclosure Quality	1	0	0,01	0,005
Gender Diversity	1	0	0,01	0,007
Tax Avoidance	1	0	0,011	0,006
Real Earnings Management	2	47,211	0,013	0,059
Audit Quality	2	24,719	0,012	0,037
Discretionary Accruals	2	0	0,011	0,018
Family Ownership	2	0,742	0,012	0,02
Accrual Earnings Management	2	0,03	0,011	0,015
Indonesia	2	0,227	0,012	0,019
Institutional Ownership	2	0,158	0,011	0,016
Financial Performance	2	0	0,011	0,009
Board Diversity	2	0	0,01	0,006
Political Connections	2	0	0,011	0,011
Collins Ntim	3	0	0,011	0,019
United Kingdom of Great Britain and Northern Ireland	3	0	0,011	0,019
University of Southampton	3	0	0,011	0,019
Accounting	3	0	0,011	0,012
Ownership Structure	4	4,383	0,012	0,021
Vietnam	4	1,531	0,011	0,015
Managerial Ownership	5	0,854	0,012	0,016
Foreign Ownership	5	0	0,011	0,011
Audit Fees	6	0,226	0,009	0,01
Auditor Independence	6	0,911	0,01	0,008
Earning Management	7	87,054	0,011	0,022
Ceo Duality	8	0	0,007	0,008
Board Size	9	0	0,007	0,006

Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 10. Visualization of Co-occurrence Network
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 10 shows keyword relationships in a co-occurrence network. Larger nodes mark more frequently occurring keywords. Edges show the strength of the association between two keywords. The visualization uses different colors to group keywords into thematic clusters. This provides an overview of the literature's developmental direction. The analysis puts earnings management at the center, with the highest betweenness value (487.33) and a PageRank of 0.193. This confirms earnings management as the key topic linking other themes in the literature on corporate governance and financial statement fraud. Corporate governance is the second most important keyword, with a betweenness value of 373.482. This demonstrates its role as a main framework for discussing financial statement fraud. These two keywords are core themes. Earnings management is often considered a form of corporate governance deviation.

In addition to these central nodes, several other keywords play a significant role in expanding the discourse. For example, the audit committee, audit quality, and the board of directors emphasize the importance of internal corporate oversight mechanisms. These mechanisms are believed to influence the prevention of financial statement manipulation significantly. Keywords such as "fraudulent financial reporting" and "financial statement fraud" underscore that the research agenda focuses on detecting and preventing irregularities in financial reporting. The clustering observed in the network also reveals notable patterns. Cluster 1 (red) centers on earnings management and corporate governance. It serves as the overarching umbrella of the discourse. Cluster 2 (blue) encompasses themes such as real earnings management, audit quality, family ownership, and institutional ownership. It highlights variations in forms of financial statement manipulation and the ownership factors that influence them. Cluster 3 (green) is distinct, as it connects researcher names, such as Collins Ntim, and affiliations, like the University of Southampton. This illustrates contributions from academics outside the ASEAN region in the development of this literature. Cluster 4 (purple) focuses on ownership structure and variations in corporate ownership mechanisms. In contrast, Cluster 5 (orange) emphasizes managerial ownership and foreign ownership. This indicates that the ownership structure remains a crucial factor in understanding managerial behaviour.

Contextual keywords such as Malaysia, Indonesia, and Vietnam reflect the significant contributions of ASEAN countries to this literature. Previous findings show Malaysia and Indonesia are leading contributors to publications on corporate governance and financial statement fraud. This literature review covers global issues and demonstrates strong ties to local and regional contexts. The analysis shows that research on corporate governance and financial statement fraud mainly focuses on earnings management, corporate governance, and auditing mechanisms. Still, connections with ownership themes, country contexts, and contributions from specific scholars

offer further avenues for exploration. First, future research can analyze how family, institutional, and managerial ownership affect the potential for fraud. Second, international collaboration, as seen in non-ASEAN authors and institutions, can deepen cross-country comparisons. Third, combining regional factors, such as those in ASEAN, with global theoretical frameworks can create more relevant research for corporate governance and fraud issues across jurisdictions.

3.5 Corporate Governance and Financial Statements Fraud Research for Future Directions

3.5.1 Theoretical Foundations

Table 8: Theoretical Foundations

Theory	**Description**	**Corporate Governance and Financial Statement Fraud Rationalization**	**Example**
Agency Theory	Explains the conflict of interest between shareholders (principals) and managers (agents) due to information asymmetry, which may encourage fraud. Effective governance is necessary to mitigate this conflict	Corporate governance functions as a mechanism to minimize conflicts of interest and information asymmetry between managers and shareholders, thereby reducing the potential for financial statement fraud	Mohd-Saleh et al. (2007); Siregar & Utama (2008); Jaggi et al. (2009); (Mahrani & Soewarno, 2018)
Institutional Theory	Focuses on the influence of regulations, norms, and external pressures on corporate practices. Institutional demands shape governance and transparency	Regulatory pressures, norms, and institutional practices encourage companies to implement strong governance and transparency, thereby minimizing fraudulent practices to meet the expectations of external stakeholders	Peng et al. (2010); Bruton et al. (2009); Kristanti et al. (2024)
Stakeholder Theory	Recognizes a company's obligation to address the interests of multiple stakeholders. Fraud erodes stakeholder trust, underscoring the importance of transparency and effective governance	Corporate governance ensures the fulfillment of stakeholder interests. Effective governance reduces the risk of financial statement fraud, which can damage stakeholder trust	Zu & Song (2009); Mahrani & Soewarno (2018); Riyadh et al. (2024)
Legitimacy Theory	Highlights how companies seek to maintain social legitimacy by adhering to societal norms. Governance serves to protect reputation and avert the consequences of fraud	Companies require public legitimacy to sustain operations. The implementation of robust governance prevents financial statement fraud, which could harm a company's reputation and public trust	Amran & Devi (2008); Gunawan (2015); Mahrani & Soewarno (2018)
Signaling Theory	Describes how companies communicate with markets and stakeholders via information disclosure, conveying quality, commitment, and performance	Effective corporate governance promotes transparent financial reporting as a positive signal to investors and stakeholders. Conversely, financial statement fraud conveys a negative signal, undermines reputation, reduces market trust, and indicates weak governance mechanisms	Utomo & Mawardi (2024); Ghaleb et al. (2022); Thinh et al. (2022)

Source: Authors Compilation, 2025

Over the past two decades, the literature on corporate governance and financial statement fraud has employed distinct theoretical foundations to analyze their interplay. These theories offer clear conceptual frameworks for understanding the drivers of fraud and the effectiveness of governance mechanisms in curbing it. As shown in Table 8, several prominent theories are frequently utilized, including Agency Theory, Institutional Theory, Stakeholder Theory, Legitimacy Theory, and Signaling Theory. These five theories collectively elucidate the role of corporate governance as the primary tool for deterring and mitigating financial statement fraud, while enhancing investor trust and organizational legitimacy.

3.5.2 Thematic Maps

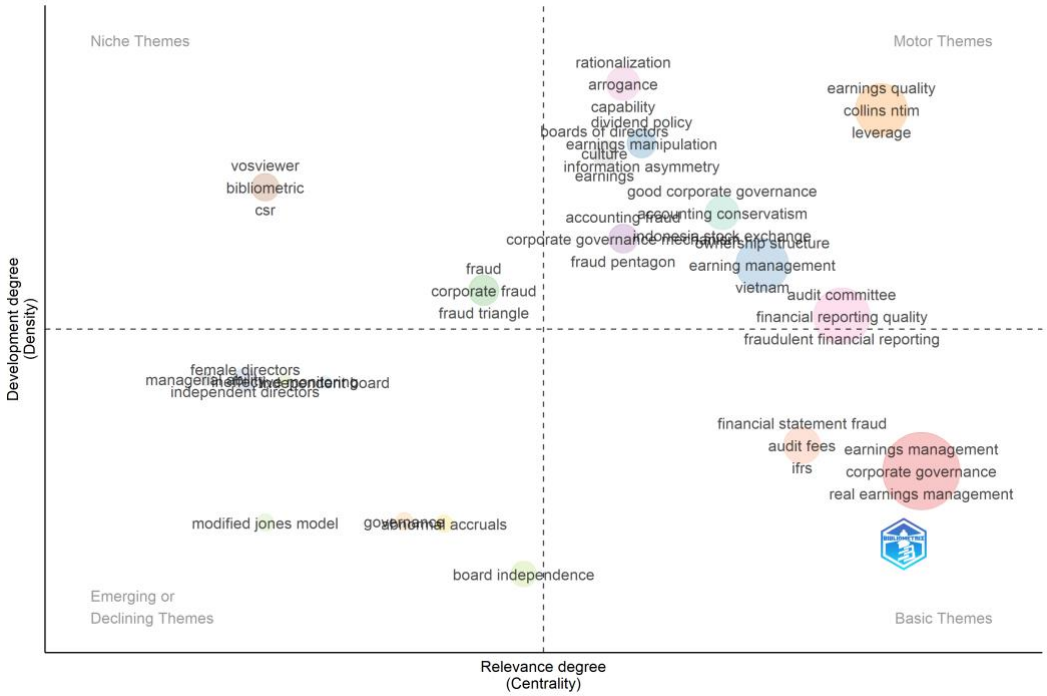

Figure 11. Thematic Map by Keywords
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

To identify the conceptual structure and evolution of this research domain, a thematic mapping analysis is conducted. The thematic map categorizes research themes into four quadrants based on two dimensions: centrality (the interaction between themes) and density (the strength of internal relationships among keywords). This classification reveals motor themes, basic themes, niche themes, and emerging or declining themes. Motor Themes, located in the upper-right quadrant, exhibit high centrality and density, serving as the field's primary pillars. Corporate governance, agency theory, the board of directors, the audit committee, ownership structure, and earnings management are key areas of focus. The close link among these elements confirms agency theory as the primary theoretical framework for studying governance mechanisms, such as board structure, audit committees, and ownership, in mitigating earnings management. Basic Themes appear in the lower-right quadrant, exhibiting high centrality but low density. These transversal concepts, including financial reporting quality, intellectual capital, signaling theory, legitimacy theory, board independence, and audit quality, are important to the field but have not yet been fully articulated as distinct research clusters. Their positions indicate they frequently serve as antecedent or consequential variables to motor themes, such as how board effectiveness influences financial reporting quality.

Niche Themes occupy the upper-left quadrant and exhibit high density but low centrality. These themes are internally robust, with strong theoretical foundations, yet interact minimally with central themes, making them specialized. Unlike the more integrated motor and basic themes, this quadrant addresses niche topics such as stewardship theory, stakeholder theory, board diversity, family ownership, institutional ownership, and firm size. Family and institutional ownership expand on the motor theme of ownership structure, while board diversity

represents a specialized area within the field of board studies. The lower-left quadrant comprises Emerging or Declining Themes, distinguished by low centrality and low density. These themes are peripheral and underdeveloped in the literature. Examples include resource dependence theory, corporate social responsibility, financial performance, firm value, and risk management. The positions of CSR and financial performance suggest that, although relevant, these themes are not yet fully integrated into core governance research. This presents opportunities for future research to explore how governance mechanisms connect with these issues.

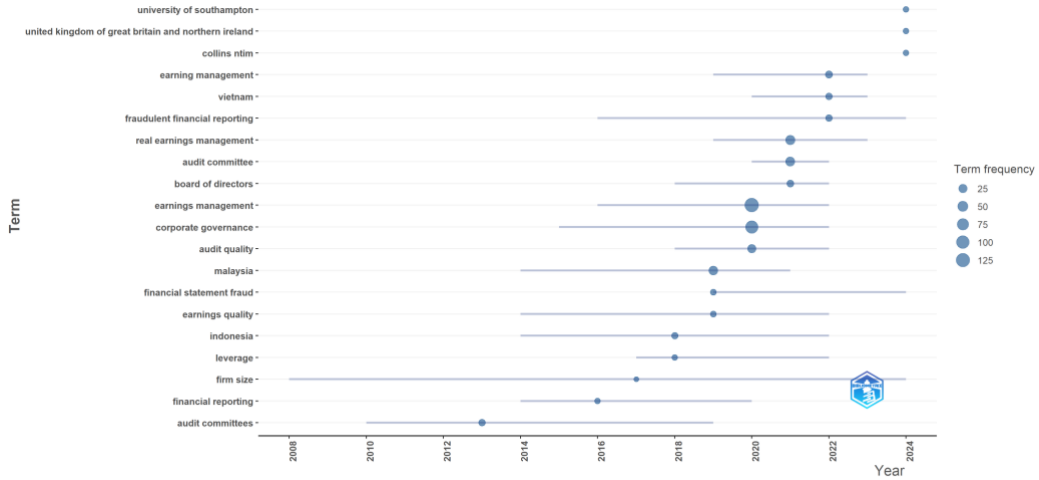

Figure 12. The Topic of Trends Over the Last Decade
Source: Processed Using Bibliometrix R-Package (Biblioshiny), 2025

Figure 12 presents a timeline plot illustrating the evolution of key topics within this research domain from 2008 to 2021. Each theme is represented by a horizontal line indicating the period during which the theme is active in the literature. The size and color of the nodes along each line indicate the cumulative frequency of the keywords, where larger and darker nodes signify peak publication activity in a given year. During the early period (approximately 2008–2012), fundamental themes, including earnings management, ownership structure, and financial performance, dominated the literature. Notably, earnings management receives consistent attention across the entire period, with peaks in publication activity in 2011 and 2018, reflecting its ongoing relevance. As the timeline advances to the middle period (approximately 2013–2018), research focus shifts significantly to corporate governance mechanisms, the board of directors, and audit committees. In particular, corporate governance attracted heightened interest from 2014 to 2018, signaling a shift from identifying issues, such as earnings management, toward analyzing solutions and control mechanisms. This progression sets the stage for recent trends in the latter period (2019–2021), where research topics diversify, and themes such as corporate social responsibility and board diversity gain increasing attention. This shift illustrates an expansion of the research focus from internal governance issues toward broader social and ethical aspects. The emergence of these themes suggests that future research is likely to explore how non-traditional governance dimensions, such as diversity and social responsibility, interact with corporate practices and performance.

4. Conclusion

In conclusion, the literature on corporate governance and financial statement fraud in the ASEAN region demonstrates rapid development over the past two decades, with publication trends increasing significantly since 2018. Bibliometric analysis of 269 articles confirms that the core theme in this literature is earnings management, which consistently serves as the primary focus of research, followed by governance mechanisms such as audit committee effectiveness, audit quality, and ownership structure. This study effectively maps the research landscape by (1) identifying the most influential journals, authors, universities, and countries in this field; (2) revealing the most cited articles as foundational literature; (3) illustrating the intellectual structure through co-citation and collaboration network analyses; and (4) proposing future research agendas based on thematic mapping. Findings indicate that Malaysia and Indonesia dominate both in terms of productivity and citation impact, while other ASEAN countries remain relatively underexplored. This suggests potential opportunities for expanding

research in countries with diverse regulatory and institutional contexts. Regarding publication outlets, journals such as Cogent Business and Management, Asian Review of Accounting, and Corporate Governance (Bingley) serve as the primary outlets for disseminating research. However, contributions from regional journals continue to strengthen the literature. The evolution of research themes also reflects a shift from general determinants of fraud toward more specific governance mechanisms, including board independence, audit quality, and family and institutional ownership.

Furthermore, the study finds that international collaboration networks are relatively strong, particularly between Malaysia, Indonesia, and global partners such as Australia and Singapore, although coverage across the region remains uneven. Emerging issues such as board diversity, corporate social responsibility, and risk management gain attention in the literature, albeit in marginal positions. This opens avenues for further research to integrate social, ethical, and sustainability dimensions into governance frameworks as a means of fraud prevention. However, several limitations should be acknowledged. First, this study analyzes only English-language Scopus-indexed articles, thereby excluding local-language publications and works not included in this database. Second, bibliometric analysis heavily relies on the quality of metadata and citation data, so relevant articles with few citations or recently published works may be overlooked. Third, the results are influenced by the selection of keywords determined from prior literature, introducing a potential risk of bias in defining the research scope.

Nevertheless, the methodology employed provides a comprehensive and objective quantitative overview of the development of corporate governance and financial statement fraud literature in ASEAN. This study makes a significant contribution by filling gaps in previous reviews that remain partial or narrative, and by offering a roadmap for future research. Subsequent studies are encouraged to extend investigations to other ASEAN countries, explore the roles of ownership structures and institutional factors more deeply, and integrate cross-disciplinary issues such as sustainability, ethics, and financial risk. Accordingly, this research is expected to serve as a crucial foundation for advancing theory and practice in corporate governance, with a focus on preventing financial statement fraud in the ASEAN region and broader global contexts.

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Informed Consent Statement/Ethics approval: Not applicable.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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Bank Competition and Monetary Policy: Evidence from Taiwan

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Abstract
This paper examines the role of bank competition for the transmission of monetary policy through the bank lending channel, using bank level data of Taiwan over the period from 2006 to 2020. And the parts of banks' characteristics, i.e., size, capitalization and liquidity, playing in the banks' response to monetary policy shocks are also considered. Our results suggest that banks with market power, which is proxied by the Lerner index, have a credit supply that is less sensitive to monetary policy shock. Therefore, increased competition enhances the effectiveness of monetary policy transmission through the bank lending channel. These findings are robust in relation to alternative measures of bank competition such as CR3, CR5 and HHI. In terms of policy implications, following the global financial crisis, the literature indicates the macroprudential policies requiring banks to raise capital to improve financial stability may have adverse effect on bank competition. Therefore, the monetary authority should be concerned and cope with the weakening impact on the efficacy of monetary policy from the increase in market concentration accompanied with the implementation of the macroprudential policies.

Keywords: Bank Competition, Bank Lending Channel, Monetary Policy Transmission, Lerner Index

1. Introduction

The literature suggests that the effects of monetary policy on the macroeconomy are transmitted through several channels, including the interest rate channel, the credit channel, and the risk-taking channel. These mechanisms enable policymakers to stabilize output fluctuations, control inflation, and smooth business cycle dynamics. The interest rate channel emphasizes the impact of monetary policy–induced interest rate changes on loan demand, whereas the credit and risk-taking channels highlight the lending behavior of financial intermediaries and the role they play in transmitting policy effects.

The credit channel can be further divided into the balance sheet channel and the bank lending channel. The balance sheet channel focuses on how interest rate fluctuations affect asset values and borrowers' net worth, thereby

influencing repayment capacity and the cost of borrowing. The bank lending channel, in contrast, concerns the direct impact of monetary policy on the lending activities of depository institutions (Bernanke and Gertler, 1995). According to Bernanke and Blinder (1988), monetary policy alters banks' asset structures, which in turn affects loan supply. Monetary tightening (easing) reduces (increases) reserves and deposits, thereby lowering (expanding) the amount of funds available for lending and leading banks to curtail (increase) credit. Romer et al. (1990), however, argue that under tightening, banks may substitute toward market-based funding—for instance, by issuing certificates of deposit—to offset the decline in loanable funds, thereby weakening the lending channel. Stein (1988) notes that the extent of this offset depends on banks' access to, and the cost of, alternative funding sources. Bernanke (2007) and Disyatat (2011) further emphasize that banks' ability to raise external funds, as well as the size of the external finance premium, depends critically on their balance sheet strength and creditworthiness. Monetary tightening can erode asset quality and raise risk exposures, thereby weakening balance sheets, increasing the external finance premium, raising funding costs, and ultimately reducing banks' willingness to lend to firms and households.

Empirical work on the credit supply effects of monetary policy typically follows the framework of Bernanke and Blinder (1988), using aggregate lending data to test the existence and operation of the lending channel. A key challenge, however, is that aggregate data cannot disentangle whether declines in lending under monetary tightening reflect reduced supply or weaker demand, complicating interpretation (Kashyap and Stein, 2000). To address this limitation, Kashyap and Stein (1995) employ disaggregated, bank-level data, allowing them to examine the role of bank-specific characteristics in shaping the transmission of monetary policy to credit supply.

Evidence suggests that the strength of the lending channel depends on bank heterogeneity. Larger, better capitalized, and more liquid banks are less likely to contract lending under monetary tightening compared with smaller, weaker institutions. Beyond such bank-specific traits, competition in the banking sector is another key factor that can amplify or dampen the lending channel and, in turn, the effectiveness of monetary policy. Beck et al. (2004) and Cetorelli and Strahan (2006) find that competition reduces the cost of financial intermediation and improves access to credit for firms and households. By contrast, Pruteanu-Podpiera et al. (2008) argue that competition undermines lending relationships, reduces management efficiency, and may encourage risk-taking behavior. Kashyap and Stein (1995) also note that both concentration and soundness in the banking sector shape policy transmission.

The theoretical literature provides conflicting views on the role of bank competition. Olivero et al. (2011a) suggest that aggressive competition, particularly by large banks seeking greater market share, may weaken policy effectiveness. On the other hand, greater competition may also increase the responsiveness of lending rates to policy rate changes, thus strengthening transmission. Chong et al. (2013) advanced two explanations: the information hypothesis, which posits that credit supply increases with market concentration, and the market power hypothesis, which suggests that stronger competition enhances firms' access to credit and improves policy effectiveness. Similarly, Freixas and Rochet (1997) and Stiglitz and Greenwald (2003) argue that competition diminishes policy transmission, whereas Alencar and Nakane (2004) and Ghossoub et al. (2012) find that it strengthens it. Overall, theoretical contributions remain inconclusive.

Empirical findings are likewise mixed. Olivero et al. (2011b), Chong et al. (2013), Fungáčová et al. (2014), and Leroy (2014), using data from Asia, Latin America, China, and the euro area, report that greater banking concentration weakens the lending channel, implying that competition strengthens monetary transmission. In contrast, Olivero et al. (2011a), Amidu and Wolfe (2013), and Yang and Shao (2016) conclude that higher concentration enhances policy effectiveness, while competition undermines it. Khan et al. (2016), studying ASEAN countries, show that results vary depending on the competition measure. Using the top-five concentration ratio (CR), the Herfindahl-Hirschman Index (HHI), or the Lerner index, they find that competition strengthens the lending effect of monetary policy. However, using the Boone indicator yields the opposite conclusion. Thus, consistent with the theoretical debate, empirical evidence shows that the effect of bank competition on policy transmission varies across countries, datasets, and measurement approaches.

Research on Taiwan's banking sector has primarily relied on aggregate data. Lai (2002) finds little evidence for a significant credit channel. Wu (2004) reports that the credit, interest rate, and exchange rate channels all play a role in policy transmission. Wu and Chen (2010) identify both narrow and broad credit channels. Hung and Yu (2015) demonstrate that banks' lending portfolios are sensitive to monetary shocks, underscoring the importance of the lending channel. Chang et al. (2010), using bank-level panel data, confirms that monetary policy is transmitted via the lending channel.

Overall, whether based on aggregate or bank-level analysis, most studies conclude that the lending channel plays a non-negligible role in Taiwan. However, little attention has been paid to how bank size, capitalization, liquidity, and competition condition the strength of this channel. To fill this gap, this study uses bank-level panel data for Taiwan and proxies' competition using the Lerner index, the HHI, the three-bank concentration ratio (CR3), and the five-bank concentration ratio (CR5). Results based on the Lerner index indicate that the effectiveness of monetary policy in influencing lending declines as the Lerner index rises, implying that higher concentration or weaker competition diminishes the role of the lending channel in smoothing the business cycle. Conversely, greater competition strengthens policymakers' ability to manage cyclical fluctuations. Estimates using the HHI, CR3, and CR5 yield consistent results: higher concentration reduces the effectiveness of the lending channel, whereas competition enhances it. These findings remain robust even after controlling for the effects of the global financial crisis and interactions between bank characteristics and monetary policy.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 outlines the research methodology. Section 4 describes the data and presents empirical results. Section 5 concludes.

2. Literature Review

The impact of bank competition on the transmission of monetary policy through the lending channel has been widely debated, with scholars advancing competing hypotheses and empirical findings.

Olivero et al. (2011a), Chong et al. (2013), and Leroy (2014) present different perspectives. Olivero et al. (2011a) argue that if competition arises because large banks seek to expand market share, this will diminish the effectiveness of the lending channel. Large banks have easier access to external funding sources; as their market share rises with greater competition, the contractionary effect of monetary tightening on loan supply is weakened. Moreover, competition reduces information asymmetries among lenders regarding borrower creditworthiness. Traditionally, banks hold superior private information about their established clients, which, combined with switching costs, creates a lock-in effect that limits borrowers' ability to shift to other banks. When smaller banks are constrained under monetary tightening, their clients cannot easily be absorbed by larger banks. Thus, if competition reduces information asymmetries and lowers switching costs, the contractionary impact of monetary tightening is weakened. Finally, Olivero et al. note that competition also affects the degree of interest rate pass-through. With greater competition, loan rates are more responsive to changes in marginal costs, implying a stronger transmission of policy rate adjustments to lending rates. From these three perspectives, bank competition may either weaken or strengthen the lending channel, depending on the dominant mechanism.

Chong et al. (2013) apply two hypotheses-Petersen and Rajan's (1995) information hypothesis and the market power hypothesis-to explain the effect of bank competition. The information hypothesis suggests that when credit markets are more concentrated, lenders internalize the benefits of providing credit to opaque or credit-constrained firms, thereby expanding credit supply to these firms. By contrast, the market power hypothesis posits that as competition increases, lending rates decline, improving credit access for all firms regardless of transparency, and thus strengthening policy transmission.

Leroy (2014) offers yet another view, arguing that as banks' market power increases, they obtain funds from financial markets more easily and on better terms, enabling them to insulate their lending from monetary shocks. In this sense, greater competition enhances the transmission of monetary policy through the lending channel.

From a theoretical standpoint, conclusions also diverge. Freixas and Rochet (1997), using the Monti–Klein model of oligopolistic banking, show that the responsiveness of lending rates to interbank rates diminishes with stronger competition, implying weaker policy transmission. Stiglitz and Greenwald (2003), using a mean–variance framework, argue that monetary tightening has weaker effects on bank lending in competitive environments than in more restricted settings. Both studies suggest that competition weakens policy transmission. In contrast, Ghossoub et al. (2012), employing an overlapping generations model, find that monetary policy is more expansionary under perfect competition and less effective under monopoly structures. Similarly, Alencar and Nakane (2004), using a dynamic general equilibrium model, conclude that macroeconomic responsiveness to interest rate changes increases with competition. Overall, theoretical models, like the hypotheses above, offer no consensus on whether competition amplifies or diminishes monetary policy effectiveness.

Empirical studies have employed various measures of bank competition, including the Lerner index, CR3 and CR5 concentration ratios, the Herfindahl–Hirschman Index (HHI), Panzar and Rosse's (1987) PRH statistic, and the Boone indicator. Findings remain mixed.

Several studies support the view that competition strengthens monetary transmission. For example, Olivero et al. (2011b), using CR5 and HHI for a sample of 936 banks across eight Asian and ten Latin American countries (1996–2006), find that greater concentration weakens the lending channel, implying that competition enhances transmission. The effect is particularly pronounced for smaller banks, while liquidity and capitalization show no significant moderating role. Similarly, Chong et al. (2013), analyzing Chinese SMEs with CR3 and HHI as proxies, find that lower concentration eases credit constraints, suggesting that competition facilitates credit access and strengthens monetary transmission. Leroy (2014), using the Lerner index with euro area bank data (1999–2011), finds that greater market power reduces the responsiveness of lending to monetary policy, while smaller, less liquid, and undercapitalized banks are more sensitive to policy shocks. Fungáčová et al. (2014), using Lerner indices for 12 euro area countries (2002–2010), report that higher market power dampens the effect of monetary policy—although this effect is only evident before the global financial crisis, not afterward. They also find that smaller, more liquid, and better-capitalized banks are more resilient to shocks. Results remain robust when CR5 and PRH are used as competition measures.

By contrast, other studies conclude that competition weakens policy transmission. Olivero et al. (2011a), using the PRH statistic for banks in Asia and Latin America (1996–2006), find that competition reduces the effectiveness of the lending channel, particularly in Latin America and among smaller, less liquid, and undercapitalized banks. Amidu and Wolfe (2013), analyzing 978 banks in 55 countries across Africa, Asia, Europe, and the Americas, show that higher market power (measured by the Lerner index) strengthens monetary policy effects in the global sample. This result holds for Africa and the Americas but is statistically insignificant for Asia and Europe. Yang and Shao (2016), using Chinese bank data (2003–2014), also find that competition weakens the lending channel, with the dampening effect more pronounced for banks with higher liquidity and capitalization.

Still other studies yield inconclusive evidence. Khan et al. (2016), analyzing five ASEAN countries (1998–2014), find that when competition is measured by CR5, HHI, or the Lerner index, monetary policy transmission is strengthened with greater competition. However, when the Boone indicator is used, the opposite result emerges. They also find that banks with larger size, higher liquidity, and stronger capitalization show stronger responses to policy shocks.

Taken together, evidence from hypotheses, theoretical models, and empirical analyses shows no consensus. Even within similar regions, different measures of competition may yield opposite conclusions—for example, Olivero et al. (2011a) versus Olivero et al. (2011b) for Asia and Latin America. Nevertheless, studies using concentration ratios or HHI tend to consistently support the view that greater competition strengthens monetary policy transmission (Olivero et al., 2011b; Chong et al., 2013; Fungáčová et al., 2014; Khan et al., 2016). Regarding bank-specific characteristics, many studies conclude that smaller, less liquid, and undercapitalized banks are more sensitive to monetary policy shocks, although Khan et al. (2016) report the opposite.

Research on Taiwan has largely relied on aggregate data. Lai (2002), using a semi-structural VAR model, examines whether the credit channel remained significant following financial liberalization and innovation (1981–1999) and finds limited evidence for its existence. Wu (2004), using a VAR approach, shows that credit, interest rate, and exchange rate channels all transmit policy effects. Wu and Chen (2010), using a macroeconometric model, confirm the existence of both narrow and broad credit channels. Hung and Yu (2015), analyzing commercial bank lending by portfolio category (1997–2011), find that loan composition is significantly influenced by monetary shocks, underscoring the lending channel's importance. Chang et al. (2010), using bank-level panel data, find that monetary policy is transmitted through the lending channel, with asset size and liquidity also shaping transmission.

Overall, studies on Taiwan suggest that the lending channel plays an important role in transmitting monetary policy effects, and that balance sheet characteristics influence the strength of transmission. However, little attention has been paid to the role of bank competition or capitalization in this process. Moreover, while Chang et al. (2010) incorporate measures of bank size and liquidity, they use nominal values of assets and liquid holdings rather than standardized measures as recommended by Ehrmann et al. (2003) and Gambacorta (2005). These authors argue that nominal asset levels exhibit time trends that should be removed to avoid spurious effects.

In sum, the literature indicates that bank competition may either strengthen or weaken monetary policy transmission, depending on context, measurement, and bank-specific characteristics such as size, liquidity, and capitalization. This study contributes to the debate by using panel data for Taiwanese banks to analyze whether competition enhances or dampens the lending channel, how bank-specific traits condition policy effects, and whether these relationships change once competition is explicitly considered.

3. Research Methodology

The role of bank competition in the transmission of monetary policy can be examined through a regression framework that incorporates changes in bank lending, monetary policy variables, bank-specific characteristics, and key macroeconomic indicators. This relationship is specified as in equation (1):

$$\begin{aligned}\Delta \ln Loan_{i,t} &= \alpha_i + \beta \Delta \ln Loan_{i,t-1} + \sum_{j=0}^{1} \gamma_j \Delta M_{t-j} + \phi Comp_{i,t-1} \\ &+ \sum_{j=0}^{1} \eta_j \Delta M_{t-j} Comp_{i,t-1} + \lambda Size_{i,t-1} + \rho Cap_{i,t-1} \\ &+ \delta Liq_{i,t-1} + \sum_{j=0}^{1} \upsilon_j y_{t-j} + \sum_{j=0}^{1} \omega_j \pi_{t-j} + \sum_{j=0}^{1} \xi_j ex_{t-j} + \varepsilon_{i,t}\end{aligned} \tag{1}$$

where $i = 1, \cdots, N$ denotes the number of banks, and $t = 1, \cdots, T$ represents the time period. $\Delta \ln Loan_{i,t}$ refers to the logarithmic change in bank lending, while ΔM_{t-j} captures monetary policy shocks. $Comp_{i,t-1}$、$Size_{i,t-1}$、$Cap_{i,t-1}$以及 $Liq_{i,t-1}$ denote, respectively, bank competition, size, capitalization, and liquidity, measured at the bank level. y_t, π_t, and ex_t represent the key macroeconomic variables such as economic growth, inflation, and exchange rate fluctuations. Since shifts in the macroeconomic environment influence loan demand, these variables are included in the model to control for the impact of aggregate conditions and demand-side factors on bank lending.

In the specification of equation (1), the lagged change in lending is included as an explanatory variable to capture the inertial dynamics of loan growth (Leroy, 2014; Fungáčová et al., 2014; Yang & Shao, 2016). Since monetary policy itself exhibits inertia, both the contemporaneous and one-period lagged monetary policy variables are incorporated into the regression equation. To mitigate potential simultaneity bias, bank-specific characteristics—including competition, size, liquidity, and capitalization—are introduced with a one-period lag (Leroy, 2014).

Key macroeconomic variables, such as economic growth and inflation, are also added to control for demand-side influences on lending behavior (Olivero et al., 2011a). Furthermore, because banks' lending responses to monetary policy may depend on their individual characteristics and funding capacity, the inclusion of bank size, liquidity, and capitalization helps account for these heterogeneous effects.

The central question whether bank competition shapes the transmission of monetary policy through the lending channel is addressed by incorporating the interaction term between monetary policy and bank competition such as $\Delta M_{t-j} Comp_{i,t-1}$ in equation (1). A positive and statistically significant coefficient represented by η_j on this interaction would suggest that greater competition dampens the transmission of monetary policy via the lending channel. Conversely, a negative and statistically significant coefficient would indicate that competition enhances the effectiveness of monetary policy transmission through bank lending.

The construction of bank-specific variables namely size, liquidity, and capitalization follows the methodology of Ehrmann et al. (2003) and Gambacorta (2005), and is specified in equation (2):

$$
\begin{aligned}
Size_{i,t} &= \log A_{i,t} - \frac{1}{N_t}\sum_i \log A_{i,t} \\
Cap_{i,t} &= \frac{C_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{C_{i,t}}{A_{i,t}}\right) \\
Liq_{i,t} &= \frac{L_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{L_{i,t}}{A_{i,t}}\right)
\end{aligned}
\tag{2}
$$

In equation (2), $A_{i,t}$ denotes the total assets of bank i at time t, $L_{i,t}$ represents its liquid assets, and $C_{i,t}$ refers to its equity. The specification in equation (2) indicates that each bank-specific variable is standardized by subtracting the corresponding sample mean. As noted by Ehrmann et al. (2003) and Gambacorta (2005), this standardization ensures that the sum of each bank characteristic across the sample equals zero. Consequently, the interaction terms between monetary policy and bank characteristics also sum to zero, allowing the estimated coefficient of the monetary policy variable to reflect the overall effect of monetary policy on loan supply.

With respect to the bank size variable, the standardization is performed period by period. This approach removes the trend component that may arise from the secular growth of bank assets over time, thereby ensuring that the size measure captures only relative differences across banks.

Regarding the selection of monetary policy variables, financial innovation and deregulation have rendered traditional monetary aggregates—such as the growth rates of M1, M2, or the monetary base—unsuitable as indicators of monetary policy stance (Bernanke & Mihov, 1998). Consequently, the literature has employed money market interest rates (Olivero et al., 2011a; Olivero et al., 2011b; Amidu & Wolfe, 2013; Khan et al., 2016) or the overnight interbank lending rate (Fungáčová et al., 2014) as alternative proxies. Changes in monetary policy are typically measured by interest rate variations (Olivero et al., 2011a; Olivero et al., 2011b; Amidu & Wolfe, 2013; Khan et al., 2016; Fungáčová et al., 2014), by the gap between the policy rate and the natural interest rate, or by the deviation of the policy rate from the rate implied by the Taylor rule (Altunabs et al., 2014; Özşuca & Akbostancı, 2016).

With respect to bank competition variables, this study employs several alternative measures, namely concentration ratios, the Herfindahl–Hirschman (HH) index, and the Lerner index (Olivero et al., 2011b; Khan et al., 2016). The concentration ratio and HH index are derived from the structural approach in traditional industrial organization literature, which infers the degree of competition from the market structure. In this framework, the concentration ratio is calculated as the asset share of the three (CR3) or five (CR5) largest banks relative to the total assets of the banking industry, while the HH index is obtained by summing the squared market shares of individual banks,

measured in terms of their assets. Since both indicators rely on market concentration to infer competition, higher concentration ratios or HH index values indicate greater market concentration and thus lower levels of competition.

By contrast, the Lerner index is derived from the framework of the New Empirical Industrial Organization (NEIO), which adopts a non-structural approach by inferring the degree of market competition from firms' conduct rather than market structure. The Lerner index is calculated as follows:

$$Lerner_{i,t} = (price_{i,t} - mc_{i.t}) / price_{i,t} \tag{3}$$

where $price_{i,t}$ denotes the price of total assets for bank i at time t, defined as the ratio of total revenue to total assets. $mc_{i.t}$ represents the bank's marginal cost, which is derived from the transcendental logarithmic (trans-log) cost function after logarithmic transformation, as specified in equation (4) (Fernández et al., 2013).

$$\begin{aligned} \ln TC_{it} &= \beta_0 + \beta_1 \ln TA_{it} + \frac{\beta_2}{2}(\ln TA_{it})^2 + \sum_{j=1}^{3} \lambda_j \ln W_{jit} \\ &+ \frac{1}{2}\sum_{j=1}^{3} \gamma_j \ln TA_{it} \ln W_{jit} + \frac{1}{2}\sum_{j=1}^{3}\sum_{k=1}^{3} \delta_{ij} \ln W_{j,i,t} \ln W_{k,i,t} + \sum_{k=1}^{3} (\delta_i / 2) \ln W_{k,i,t} \\ &+ \theta_1 Trend + \frac{1}{2}\theta_2 Trend^2 + \theta_3 Trend \ln TA_{it} + \sum_{j=1}^{3} \varphi_j Trend \ln W_{jit} + u_{it} \end{aligned} \tag{4}$$

where TC_{it} denotes the total cost of bank i at time t, which includes the costs of funds, labor, and capital, while TA_{it} represents the bank's total assets. W_j captures the input prices, where W_1, W_2, and W_3 correspond to the prices of funds, labor, and capital, respectively. $Trend$ is included to account for the time trend of technological progress. The price of funds is measured as interest expenses on deposits divided by the sum of deposits and short-term borrowed funds; the price of labor is measured as personnel expenses relative to total assets; and the price of capital is calculated as total operating expenses net of personnel expenses, divided by total assets (Demirgüç-Kunt & Peria, 2010).

According to the trans-log cost function specified in equation (4), the marginal cost in equation (3) is defined as:

$$mc_{i.t} = \frac{TC_{it}}{TA_{it}}(\beta_1 + \beta_2 \ln TA_{it} + \sum_{j=1}^{3} \gamma_j \ln W_{jit} + \theta_3 Trend) \tag{5}$$

According to equation (3), under perfect competition, the output price equals the marginal cost, implying that the Lerner index is equal to zero. By contrast, in an imperfectly competitive market, the Lerner index takes a value greater than zero, with higher values indicating lower degrees of competition. By construction, the Lerner index ranges between 0 and 1.

Furthermore, to jointly examine how bank competition, size, liquidity, and capitalization influence the transmission of monetary policy through the lending channel, this study follows the analytical framework of Leroy (2014). Specifically, interaction terms between monetary policy and these bank characteristics are incorporated into equation (1), yielding the specification presented in equation (6).

$$\begin{aligned}\Delta \ln Loan_{i,t} = {} & \alpha_i + \beta \Delta \ln Loan_{i,t-1} + \sum_{j=0}^{1} \gamma_j \Delta M_{t-j} + \phi Comp_{i,t-1} \\ & + \lambda Size_{i,t-1} + \rho Cap_{i,t-1} + \delta Liq_{i,t-1} + \sum_{j=0}^{1} \eta_j \Delta M_{t-j} Comp_{i,t-1} \\ & + \sum_{j=0}^{1} \sigma_j \Delta M_{t-j} Size_{i,t-1} + \sum_{j=0}^{1} \tau_j \Delta M_{t-j} Cap_{i,t-1} + \sum_{j=0}^{1} \varsigma_j \Delta M_{t-j} Liq_{i,t-1} \\ & + \sum_{j=0}^{1} \upsilon_j y_{t-j} + \sum_{j=0}^{1} \omega_j \pi_{t-j} + \sum_{j=0}^{1} \xi_j ex_{t-j} + \varepsilon_{i,t}\end{aligned} \tag{6}$$

The literature has extensively examined how bank-specific characteristics—namely size, capitalization, and liquidity—shape the transmission of monetary policy through the lending channel. With respect to bank size, the argument is that the external finance premium declines as bank size increases, enabling larger banks to obtain funds from alternative sources more easily when facing a contractionary monetary policy shock. This mitigates the adverse impact of rising interest rates on lending. Based on this reasoning, the effect of monetary policy tightening is expected to diminish with bank size, and hence the coefficient on size is anticipated to be positive (greater than zero).

Turning to bank capitalization, when interest rates rise, well-capitalized banks typically hold more ample lending capacity (Kashyap & Stein, 1995), or they may attract deposits and market funding on more favorable terms (Bernanke, 2007; Gambacorta & Shin, 2018). Strong capitalization also reduces the risk premium associated with debt financing, thereby enhancing banks' resilience to contractionary monetary policy. Accordingly, the impact of monetary tightening is expected to weaken as capitalization increases, implying that the coefficient on capitalization should likewise be positive (greater than zero).

The effect of liquidity, however, is more ambiguous. As summarized by Abuka et al. (2019), the expected sign may be either positive or negative. In advanced economies, highly liquid banks can adjust their asset portfolios to buffer against monetary tightening (Kashyap & Stein, 2000) or secure funding at lower costs (Bernanke, 2007). In such cases, greater liquidity attenuates the impact of monetary policy on the lending channel, suggesting a positive coefficient. By contrast, in developing economies, where financial intermediation is more costly, banks often hold substantial sovereign debt instruments such as treasury bills (Allen et al., 2011). When market interest rates rise, the costs associated with information frictions on loans also increase, encouraging banks to shift toward government securities to reduce risk exposure. This, in turn, constrains loan growth and amplifies the contractionary effect of monetary policy, implying a negative coefficient. Abuka et al. (2019) further note that such effects are magnified when banks are subject to moral suasion, whereby authorities pressure them to hold more government bonds.

In summary, the expected coefficients on size and capitalization are positive, indicating that monetary policy transmission through the lending channel weakens as banks become larger and better capitalized. By contrast, the expected sign of the liquidity coefficient is indeterminate, depending on the stage of economic development and the extent to which banks are influenced by moral suasion policies.

4. Empirical Analysis

This study employs a panel dataset comprising 33 domestic banks in Taiwan over the period 2006–2020. The data required to construct bank-specific characteristics and measures of competition were obtained from the Banking Bureau of the Financial Supervisory Commission (FSC) through its dynamic statistical database.

For the construction of bank-specific variables defined in equation (2), total assets are taken from the asset items reported in the balance sheet of domestic banks. Liquid assets are proxied by the sum of cash and cash equivalents,

together with deposits with the central bank and interbank call loans, as reported in the balance sheet. Equity is drawn from the equity item of the balance sheet.

To compute competition indicators—including the concentration ratio, the Herfindahl–Hirschman (HH) index, and the Lerner index—the following data are used: total revenue is drawn from the income items in banks' income statements, while total cost is proxied by the expenditure items in the same statement. Total assets are again taken from the balance sheet. Interest expenses on deposits are obtained from the interest expense item of the income statement. The sum of deposits and short-term funding is proxied by the aggregate of central bank deposits, interbank deposits and borrowings, postal transfers, deposits, and remittances, as reported in the balance sheet. Personnel expenses are obtained from the income statement, while total operating expenses net of personnel costs are proxied by other expenses reported in the same statement.

In the computation of the Lerner index, it is first necessary to estimate the cost function defined in equation (4). Following Koetter et al. (2012) and Leroy (2014), this study employs stochastic frontier analysis to obtain the required estimates.

In equation (1), the dependent variable loan growth is alternatively measured by the monthly average of loans outstanding (L1), the end-of-month loan balance including non-performing loans (L2), and the end-of-month loan balance excluding non-performing loans (L3). The key macroeconomic control variables include economic growth, inflation, and exchange rate fluctuations. Specifically, economic growth is proxied by the official growth rate published by the Directorate-General of Budget, Accounting and Statistics (DGBAS); inflation is measured by the annual growth rate of the Consumer Price Index (CPI); and exchange rate fluctuations are captured by movements in the New Taiwan Dollar (NTD) against the U.S. Dollar (USD). These data are obtained from the DGBAS statistical database and the Central Bank of the Republic of China (Taiwan).

The monetary policy variable is proxied by the overnight interbank call loan rate, with monetary policy shocks represented by the deviation of the policy rate from the natural interest rate. The natural interest rate is estimated using the Hodrick–Prescott (HP) filter.

For the estimation of equations (1) and (6), the use of a bank-level panel dataset raises potential endogeneity concerns, given that loan growth may expand bank balance sheets, while capitalization may change alongside bank size. Such endogeneity may bias the estimates. To address this issue, the study employs the system generalized method of moments (system GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). Under the conditions that the chosen instruments are valid and that the residuals exhibit no second-order serial correlation, the resulting estimates are both consistent and efficient (Leroy, 2014; Khan et al., 2016). The set of instruments includes lagged values of both the dependent and explanatory variables, with their validity assessed using the Hansen test of over-identifying restrictions, which evaluates whether the instruments are uncorrelated with the error term.

4.1. Lerner Index and the Effects of Monetary Policy

Table 1 reports the estimation results of equation (1), where alternative measures of loan growth are employed as dependent variables and the Lerner Index is used to capture the degree of bank competition. Regarding the interaction between monetary policy and loan growth, the estimated coefficients of γ_1 and γ_2 are negative, indicating an inverse relationship: monetary policy easing (tightening) is associated with an expansion (contraction) of bank lending. This finding is not only consistent with theoretical expectations but also highlights the role of the bank lending channel as a key transmission mechanism of monetary policy. However, in terms of statistical significance, only parts of the estimated coefficients of γ_2 is significant.

The estimated coefficients of the interaction terms between monetary policy changes and the Lerner Index, η_1 and η_2, are positive, with the coefficient of η_2 shown statistical significance. This implies that as the Lerner Index

increases, indicating higher market concentration and lower banking competition, the impact of monetary policy on loan growth is attenuated. In other words, weaker competition diminishes the effectiveness of the bank lending channel in transmitting monetary policy to the real economy. This result is consistent with the findings of Leroy (2014) and Khan et al. (2016), who conducted similar analyses for the Eurozone and ASEAN, respectively. Overall, the estimations using the Lerner Index as a proxy for banking competition suggest that enhancing competition in Taiwan's banking sector would strengthen the transmission of monetary policy through the lending channel, thereby improving the effectiveness of monetary policy in stabilizing the macroeconomy.

Regarding the effects of banking competition and bank-specific characteristics, namely size, capitalization, and liquidity, on loan growth, the estimated coefficient for banking competition (ϕ) is positive and statistically significant. This indicates that as the Lerner Index rises, implying greater market concentration and lower competition, loan expansion is facilitated. With respect to bank-specific characteristics, the coefficients for bank size (λ) and liquidity (δ) are negative and positive, respectively, but neither reaches statistical significance. By contrast, the coefficient for capitalization (ρ) is positive and statistically significant, suggesting that higher levels of capitalization contribute to loan expansion. This finding is consistent with prior literature, while the results for size and liquidity indicate that these factors do not exert a significant influence on loan growth.

With respect to the estimated coefficients of the main macroeconomic variables, those for economic growth, inflation, and exchange rate fluctuations are all positive. Among these, the coefficients for economic growth and exchange rate fluctuations are statistically significant, indicating that loan demand expands with stronger economic growth or with a depreciation of the New Taiwan Dollar, thereby contributing to higher loan growth in the financial system. Finally, the results of the Hansen test and the second-order serial correlation test show p-values exceeding the 10% level, suggesting that the instruments employed are valid and that the estimation results are robust.

Secondly, to account for the impact of the 2007–2008 global financial crisis, a dummy variable was introduced to capture the crisis effect and incorporated into equation (1) as an explanatory variable. Two alternative specifications were adopted. In the first specification, the years 2007 and 2008 were identified as the crisis period, with the dummy variable set to one during these years and zero otherwise; the corresponding estimation results are reported in Table 2. In the second specification, the crisis period was defined as spanning 2007 to 2009, with the dummy variable set to one during these years and zero otherwise; the results are presented in Table 3.

The results in Table 2 indicate that the estimated coefficients of the interaction terms between monetary policy and loan growth (γ_1 and γ_2) are negative, with γ_2 being statistically significant. The interaction terms between monetary policy and the Lerner index (η_1 and η_2) yield positive estimates, with η_2 being statistically significant. The coefficient for banking competition (ϕ) is positive, while bank size (λ) is negative, capitalization (ρ) is positive, and liquidity (δ) is positive; among these, the coefficients for ϕ , λ , and ρ are statistically significant. Regarding macroeconomic variables, the coefficients for economic growth and, in part, inflation are positive and statistically significant. The estimated coefficients for the crisis dummy variable are not statistically significant across different measures of loan growth. Overall, compared with the baseline estimates in Table 1, which do not account for the global financial crisis, the results in Table 2 remain largely consistent, with the exception that the coefficient for bank size attains statistical significance here.

The results in Table 3, which apply the second crisis dummy specification, are broadly consistent with those in Table 2. The coefficients for the interaction between monetary policy and loan growth (γ_1 and γ_2) remain negative, as in Table 2; however, γ_1 is statistically significant, while γ_2 is not, representing a slight departure from the findings in Table 2. Like Table 2, the estimated coefficients for the crisis dummy variable remain statistically insignificant across alternative loan measures.

Overall, when the impact of the global financial crisis is considered, the estimated coefficients of the crisis dummy variable under different specifications remain statistically insignificant. Regarding the effect of monetary policy on loan growth, the interaction between monetary policy changes and loan variation consistently exhibits a negative relationship, a finding that holds irrespective of whether the global financial crisis is considered. With respect to banking competition, the results indicate that the effectiveness of monetary policy declines as the Lerner index rises, implying that higher market concentration or reduced competition weakens the transmission of monetary policy through the bank lending channel in influencing macroeconomic activity. Hence, enhancing competition in the banking sector strengthens the effectiveness of monetary policy via the lending channel, and this conclusion remains robust even after incorporating the role of the global financial crisis. In terms of bank-specific characteristics, higher capitalization is found to facilitate loan expansion, whereas larger bank size may be less favorable to loan growth. By contrast, bank liquidity does not appear to exert a significant influence on changes in lending.

The analysis is further extended to examine how bank-specific characteristics, namely size, capitalization, and liquidity, affect the transmission of monetary policy, as well as how the effectiveness of monetary policy changes once these factors are incorporated alongside bank competition. To this end, equation (6) is estimated in a specification that excludes the competition variable and its interaction with monetary policy, thereby focusing solely on the role of bank characteristics. As reported in Table 4, the estimated coefficient of monetary policy variation (γ_1) is negative and statistically significant, whereas the coefficient of (γ_2) is statistically insignificant. Although this result differs from that in Table 1, loan variation continues to display an inverse relationship with monetary policy, thereby confirming that monetary policy transmits effectively through the bank lending channel. This outcome is consistent with the findings reported in Table 1.

Regarding the influence of bank characteristics on the effectiveness of monetary policy, the interaction term between bank size and monetary policy variation (σ_1) yields a statistically insignificant estimate, whereas the coefficient of (σ_2) is positive and statistically significant. This indicates that as bank size increases, the impact of monetary policy on loan variation diminishes, suggesting that the effectiveness of the bank lending channel weakens with larger banks. This finding is consistent with the literature, which posits that larger banks can more readily access alternative funding sources, thereby rendering their loan growth less sensitive to monetary tightening. For capitalization, the interaction term between bank capitalization and monetary policy variation (τ_1) is statistically insignificant, while the coefficient of (τ_2) is positive and statistically significant. This result implies that higher levels of capitalization attenuate the effect of monetary policy on bank lending, aligning with the view that well-capitalized banks, due to their more abundant internal funds or their ability to attract deposits on more favorable terms, are better equipped to withstand the adverse effects of monetary tightening on loan growth.

By contrast, the interaction term between bank liquidity and monetary policy variation (ς_1) produces a negative and statistically significant estimate at the 10% level, while the coefficient of (ς_2) is also negative but statistically insignificant. This suggests that the lending-channel effect of monetary policy is strengthened as bank liquidity increases. Following the reasoning of Abuka et al. (2019), this outcome implies that more liquid banks, in response to the heightened lending risks induced by contractionary monetary policy, are inclined to curtail loan growth and instead reallocate their portfolios toward relatively safer assets such as government securities, thereby reinforcing the contractionary effect of monetary policy transmitted through the bank lending channel.

With respect to the individual effects of bank size, capitalization, liquidity, and key macroeconomic variables on loan growth, the results reported in Table 4 indicate that the estimated coefficients of bank size (λ), capitalization (ρ), and liquidity (δ) are negative, positive, and positive, respectively, with only the coefficient ρ attaining statistical significance. These findings are consistent with those reported in Table 1. Regarding the macroeconomic variables, the coefficients of output growth, inflation, and exchange rate variation are all positive, with most

estimates statistically significant. This suggests that loan growth increases with higher economic growth, rising inflation, and depreciation of the New Taiwan dollar, which is consistent with theoretical expectations as well as with the results in Tables 1 through 3.

Subsequently, bank competition is incorporated into the analysis to examine the joint effects of competition and bank characteristics on the transmission of monetary policy. According to the results in Table 5, after accounting for bank competition, the estimated coefficient of monetary policy variation (γ_2) is statistically significant and negative, while the coefficient of the interaction term between monetary policy and the Lerner index (η_2) is positive and statistically significant. This implies that as market concentration rises and bank competition declines, the effect of monetary policy on loan growth diminishes, thereby weakening the transmission of monetary policy through the bank lending channel. This result is consistent with the conclusions drawn from Table 1.

As for the interaction terms between monetary policy and bank characteristics, most of the coefficients for bank size and liquidity are not statistically significant. By contrast, the capitalization–monetary policy interaction yields a positive and statistically significant estimate, while the liquidity–monetary policy interaction produces a negative coefficient that is significant at the 10% level. Compared with the results in Table 4, bank size no longer exhibits a robust influence on monetary policy effectiveness, while the effects of capitalization and liquidity remain in the same direction as in Table 4 but with smaller absolute magnitudes. This indicates that, once bank competition is considered, the role of bank characteristics in mediating the impact of monetary policy on loan growth is attenuated. Furthermore, the coefficient of the Lerner index interaction is larger than that reported in Table 1, underscoring the central role of bank competition in shaping the operation of the lending channel of monetary policy. Finally, the individual effects of bank size, capitalization, liquidity, and macroeconomic variables on loan growth are broadly consistent with those in Table 4, though the statistical significance of macroeconomic variables is relatively weaker.

In summary, when the Lerner index is employed as a proxy for bank competition, the empirical results indicate that the effect of monetary policy on loan growth diminishes as the Lerner index increases. This implies that higher market concentration or lower bank competition weakens the influence of monetary policy on lending activity. Accordingly, fostering greater competition in the banking sector enhances the authorities' ability to stabilize macroeconomic fluctuations through monetary policy. Moreover, this inference continues to hold even after accounting for the impact of the global financial crisis.

With respect to bank characteristics, the evidence suggests that, in the absence of competition effects, the transmission of monetary policy through the bank lending channel is attenuated as bank size expands and capitalization strengthens. This outcome reflects the fact that larger banks have easier access to alternative funding sources and that highly capitalized banks possess abundant internal resources, thereby mitigating the adverse effects of contractionary monetary policy on lending. By contrast, higher bank liquidity strengthens the transmission of monetary policy, a result consistent with Abuka et al. (2019), who argue that, in response to the elevated credit risk associated with contractionary monetary policy, highly liquid banks reallocate their portfolios toward safer government securities.

Once bank competition is incorporated, however, the interaction effects of bank characteristics and monetary policy on loan growth are reduced, underscoring the central role of bank competition in shaping the effectiveness of the monetary policy lending channel.

4.2 Robustness Analysis and Policy Implications

As a further step, the study employs structural measures of competition—including the H-H index, CR3, and CR5 as alternative proxies for bank competition, to examine whether the impact of bank competition on the effectiveness of monetary policy is consistent with the results obtained using the non-structural Lerner index. Tables 6 through 8 present the estimation results of equation (1) when the H-H index, CR3, and CR5 are respectively adopted as indicators of bank competition.

The results in Table 6 show that the estimated coefficient of monetary policy changes on loan growth (γ_1) is negative and statistically significant, whereas the corresponding alternative specification (γ_2) is insignificant. This indicates that changes in monetary policy are inversely related to loan growth, a finding consistent with theoretical expectations and with the inference drawn from Table 1. However, the significance of certain coefficients differs from that reported in Table 1.

The estimated coefficient of the interaction between bank competition and loan growth (ϕ) is positive and statistically significant, suggesting that as the H-H index rises-implying higher market concentration and reduced bank competition-loan growth tends to expand. This finding is in line with the conclusion derived from the Lerner index. By contrast, the estimated coefficients of the interaction terms between bank competition and monetary policy changes yield mixed results: the first (η_1) is positive and significant, while the second (η_2) is negative but statistically insignificant. These results imply that as the H-H index increases, the effectiveness of the bank lending channel in transmitting monetary policy is weakened. Hence, greater bank competition enhances the ability of monetary policy to stabilize macroeconomic fluctuations, consistent with the inference of Table 1.

Regarding bank-specific characteristics, the estimated coefficients for size (λ) and liquidity (λ) are statistically insignificant, while capitalization (ρ) is positive and significant. This indicates that only capitalization exerts a significant effect on loan growth, a finding like that reported in Table 1.

Tables 7 and 8 present the estimation results using CR3 and CR5 as measures of bank competition. The significance and signs of the estimated coefficients for monetary policy changes, bank competition, and the interaction terms between bank competition and monetary policy are consistent with those reported in Table 6. This indicates that the inferences derived from structural measures of market structure are robust, and they align with the conclusions obtained from the non-structural Lerner index in Table 1. Taken together, whether bank competition is captured through non-structural or structural approaches, the results from Table 1 and Tables 6 through 8 uniformly demonstrate that greater bank competition strengthens the effectiveness of monetary policy through the lending channel, thereby enhancing the authorities' ability to stabilize business cycles.

An additional question concerns whether the interactions between bank characteristics and monetary policy may alter the role of structural measures of bank competition, such as the H-H index, CR3, and CR5, in shaping monetary policy effectiveness. To address this, the study further estimates equation (6), incorporating interaction terms between bank characteristics and monetary policy, to examine whether the effect of bank competition on monetary policy outcomes changes once these bank-specific factors are accounted for. The corresponding results are reported in Tables 9 through 11.

Table 9, which employs the H-H index as the proxy for bank competition, shows that after including the interaction terms between bank characteristics and monetary policy as explanatory variables, the significance and signs of the coefficients for monetary policy changes, bank competition, and the interaction between competition and monetary policy remain the same as in Table 6. This suggests that the inference regarding the impact of bank competition on loan growth and the effectiveness of monetary policy is unaffected by the inclusion of bank-specific interactions. Similarly, the results in Tables 10 and 11, where CR3 and CR5 are used as alternative measures of bank competition, are consistent with those in Table 9.

In addition, the results in Table 9 indicate that the estimated coefficients of the interaction terms between monetary policy changes and bank characteristics show that the signs of size and capitalization are positive and statistically significant, while liquidity is negative and significant at the 10% level. The results in Tables 10 and 11 are consistent with those in Table 9. These findings suggest that the effectiveness of monetary policy through the bank lending channel is weakened as bank size expands or capitalization increases, while it is strengthened as liquidity rises. This is consistent with the inferences drawn from Tables 4 and 5.

Taken together, whether the Lerner index or structural measures such as the H-H index, CR3, and CR5 are used as proxies for bank competition, the estimation results consistently show that the effectiveness of monetary policy through the lending channel diminishes as market concentration rises. Accordingly, enhancing bank competition would help strengthen the ability of the authorities to stabilize the business cycle through monetary policy. What policy implications does this carry? In Taiwan, the Financial Supervisory Commission (FSC) has designated six domestic banks as domestic systemically important banks (D-SIBs) and required them to raise their common equity tier 1 ratio, tier 1 capital ratio, and total capital adequacy ratio to 11%, 12.5%, and 14.5%, respectively, by 2025. While such macroprudential measures, aimed at increasing capital adequacy to reduce systemic risk and enhance the resilience of the financial system, are necessary, an important question arises: what are the potential consequences for bank competition?

Regarding the impact of macroprudential policy on bank competition, Mirzaei and Moore (2021), using data from 58 countries during 2000–2013 and employing the Lerner index as the measure of competition, find that liquidity- and capital-related macroprudential policies tend to weaken bank competition. However, this negative effect diminishes as institutional quality and supervisory power improve. Scalco et al. (2021), in their analysis of Brazil, show that the strengthening of macroprudential policy increases the markup of prices over marginal cost, thereby reducing bank competition. They argue that while macroprudential policies are implemented to promote financial stability, policymakers should remain attentive to their unintended adverse effects on competition. González (2022) highlights that capital-related macroprudential measures—such as higher capital adequacy requirements for systemically important financial institutions (SIFIs)—may hinder the growth of smaller banks, thereby strengthening the market power of large incumbents, raising barriers to bank entry, and ultimately reducing competition. Similarly, Li (2022), using the tier 1 and tier 2 capital ratios to capture capital structure and the Lerner index to measure competition, finds that banking market power increases with higher tier 1 capital ratios. Moreover, institutional factors such as activity restrictions, capital stringency, and supervisory strength also exacerbate market power, further diminishing competition.

These perspectives suggest that macroprudential policies aimed at stabilizing the financial system may unintentionally undermine bank competition. Since the empirical results in this study indicate that monetary policy effectiveness is strengthened by greater bank competition, the FSC's macroprudential measures—such as raising capital requirements—may simultaneously increase market concentration, reduce competition, and weaken the transmission of monetary policy through the lending channel. Therefore, the potential trade-off between enhancing financial stability through stricter macroprudential regulation and preserving the effectiveness of monetary policy should be carefully considered and addressed by policymakers.

5. Conclusion

The literature suggests that monetary policy influences aggregate economic fluctuations through the bank lending channel by affecting the lending behavior of depository institutions. Analyses using bank-level data indicate that bank-specific characteristics, such as size, capitalization, liquidity, and the degree of competition, play critical roles in shaping the transmission of monetary policy through this channel. However, the impact of bank competition on monetary policy effectiveness remains unsettled. Hypotheses and theoretical models offer divergent predictions, and empirical evidence shows that the effect of competition varies not only across samples but also with the choice of competition measures. In the context of Taiwan, existing studies confirm the presence of the bank lending channel in the monetary transmission process but provide little discussion on the role of bank competition.

To address this gap, this study employs panel data from 33 domestic banks in Taiwan spanning 2006 to 2020 and uses the Lerner index, the H-H index, CR3, and CR5 as alternative measures of bank competition. Estimates based on the Lerner index confirm a negative relationship between monetary policy changes and loan growth, consistent with the existence of the bank lending channel as documented in prior literature. More importantly, the transmission effect of monetary policy weakens as the Lerner index rises, indicating that higher market concentration and lower competition reduce the effectiveness of monetary policy through the lending channel.

Hence, promoting greater competition strengthens the ability of monetary policy to stabilize business cycles. Similar results are obtained when the H-H index, CR3, and CR5 are employed, showing that increases in market concentration weaken the lending channel. Even after incorporating interactions between bank characteristics and monetary policy, the conclusion remains robust: higher competition enhances the effectiveness of monetary policy transmission.

From a policy perspective, the findings have important implications. In the post-global financial crisis era, under the Basel III framework, regulators have implemented macroprudential policies requiring banks to raise capital to enhance financial stability. This development has triggered growing attention to the potential consequences of macroprudential policies for bank competition. Empirical studies such as Mirzaei and Moore (2021), Scalco et al. (2021), and Li (2022) document that capital-related regulations and structural constraints tend to weaken competition, while González (2022) finds that higher capital adequacy requirements for systemically important financial institutions strengthen the market power of large banks, thereby raising barriers to entry and reducing overall competition. In Taiwan, following the designation of five banks as domestic systemically important banks (D-SIBs) in 2019 and the addition of First Bank in 2020, the Financial Supervisory Commission (FSC) has mandated a gradual increase in their minimum capital requirements. While these measures are intended to improve resilience against unexpected shocks and enhance systemic stability, they may simultaneously raise market concentration and reduce competition, which in turn could weaken the ability of monetary policy to stabilize the economic cycle. Thus, policymakers must carefully balance the trade-off between enhancing financial stability through macroprudential regulation and preserving the effectiveness of monetary policy transmission through maintaining adequate levels of bank competition.

Table 1: Monetary policy and bank competition

estimate	L1	L2	L3
β	-0.094(0.327)***	-0.134(0.037)***	-0.122(0.039)***
γ_1	-0.106(0.093)	-0.108(0.091)	-0.106(0.092)
γ_2	-0.051(0.028)*	-0.072(0.026)***	-0.067(0.024)***
ϕ	0.377(0.194)*	0.387(0.176)**	0.367(0.178)**
η_1	0.108(0.095)	0.096(0.100)	0.096(0.099)
η_2	0.118(0.071)*	0.146(0.058)**	0.142(0.060)**
λ	-0.103(0.065)	-0.101(0.070)	-0.122(0.080
ρ	3.008(0.923)***	2.318(0.913)**	2.469(1.006)**
δ	0.282(0.257)	0.239(0.159)	0.213(0.183)
υ_1	0.012(0.007)*	0.010(0.006)	0.010(0.006)
υ_2	0.007(0.004)*	0.007(0.004)*	0..006(0.004)*
ω_1	0.018(0.016)	0.018(0.015)	0.016(0.015)
ω_2	0.011(0.014)	0.013(0.012)	0.011(0.012)
ξ_1	0.001(0.001)	0.002(0.001)	0.002(0.001) *
ξ_2	0.001(0.003)	0.002(0.002)	0.002(0.002)
α	-0.228(0.143)	-0.228(0.134) *	-0.230(0.132) *
Hansen test	0.853	0.996	0.942
AR(1)/AR(2)	0.006/0.206	0.012/0.178	0.008/0.226

Note: In the parentheses are standard deviations. ***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. AR(1) and AR(2) represent first-order and second-order autocorrelation tests on

the regression residuals. The Hansen test and the AR(1)/AR(2) statistics correspond to the p-values of the tests.

Table 2: Monetary policy, bank competition and financial crisis

estimate	L1	L2	L3
β	-0.188(0.072)***	-0.137(0.040)***	-0.126(0.043)***
γ_1	-0.146(0.113)	-0.147(0.127)	-0.146(0.124)
γ_2	-0.102(0.047)**	-0.119(0.065)*	-0.114(0.064)*
ϕ	0.423(0.155)***	0.398(0.185)**	0.406(0.185)***
η_1	0.154(0.133)	0.097(0.100)	0.098(0.100)
η_2	0.146(0.036)***	0.141(0.057)**	0.137(0.059)**
λ	-0.090(0.040)**	-0.108(0.074)	-0.128(0.084)
ρ	2.064(0.934)**	2.392(0.963)**	2.551(1.051)**
δ	0.206(0.260)	0.215(0.188)	0.188(0.212)
υ_1	0.009(0.003)***	0.005(0.004)	0.006(0.005)
υ_2	0.007(0.002)***	0.005(0.002)**	0.004(0.002) *
ω_1	0.019(0.010)*	0.009(0.010)	0.008(0.011)
ω_2	0.015(0.011)	0.010(0.010)	0.008(0.010)
ξ_1	0.003(0.002)	0.003(0.002)	0.003(0.002)
ξ_2	0.002(0.003)	0.001(0.002)	0.001(0.002)
α	-0.245(0.099)**	-0.207(0.117)*	-0.209(0.116)*
Crisis dummy	0.057(0.096)	0.128(0.165)	0.126(0.159)
Hansen test	0.998	0.997	0.995
AR(1)/AR(2)	0.001/0.110	0.012/0.156	0.008/0.184

Table 3: Monetary policy, bank competition and financial crisis

estimate	L1	L2	L3
β	-0.085(0.035)**	-0.143(0.035)***	-0.123(0.037)***
γ_1	-0.150(0.089)*	-0.158(0.096)*	-0.161(0.097)*
γ_2	-0.172(0.144)	-0.167(0.094)*	-0.173(0.096)*
ϕ	0.418(0.199)**	0.476(0.182)***	0.493(0.188)***
η_1	0.169(0.130)	0.148(0.150)	0.152(0.146)
η_2	0.114(0.060)*	0.143(0.053)***	0.135(0.054)**
λ	-0.097(0.061)	-0.116(0.068)*	-0.133(0.073)*
ρ	3.085(0.793)***	2.694(0.789)***	2.846(0.879)***
δ	0.216(0.297)	0.258(0.163)	0.238(0.180)
υ_1	0.006(0.004)	0.004(0.007)	0.004(0.008)
υ_2	0.005(0.004)	0.004(0.005)	0.004(0.005)

ω_1	0.028(0.015)*	0.033(0.019)*	0.033(0.018)*
ω_2	0.028(0.018)	0.042(0.023)*	0.042(0.021)**
ξ_1	0.003(0.003)	0.001(0.004)	0.001(0.004)
ξ_2	0.006(0.004)	0.008(0.005)*	0.008(0.004)*
α	-0.256(0.133)*	-0.296(0.153)*	-0.306(0.156)**
Crisis dummy	0.094(0.128)	0.059(0.096)	0.076(0.097)
Hansen test	0.620	0.294	0.304
AR(1)/AR(2)	0.004/0.910	0.006/0.803	0.005/0.967

Table 4: Monetary policy and bank characteristics

estimate	L1	L2	L3
β	-0.140(0.049)***	-0.183(0.045)***	-0.177(0.050)***
γ_1	-0.083(0.050)*	-0.083(0.038)**	-0.087(0.038)**
γ_2	0.038(0.028)	0.015(0.028)	0.020(0.027)
λ	-0.010(0.027)	0.002(0.038)	-0.004(0.036)
ρ	2.280(0.683)***	1.973(0.834)**	1.973(0.839)**
δ	0.211(0.283)	0.027(0.190)	0.026(0.188)
σ_1	0.008(0.012)	0.010(0.011)	0.010(0.011)
σ_2	0.025(0.012)**	0.025(0.010)**	0.024(0.009)***
τ_1	-0.495(0.571)	-0.549(0.600)	0.533(0.595)
τ_2	0.527(0.125)***	0.473(0.135)***	0.471(0.138)***
ς_1	-0.825(0.604)	-0.986(0.583)*	-0.999(0.582)*
ς_2	-0.062(0.154)	-0.134(0.138)	-0.116(0.135)
υ_1	0.013(0.005)***	0.009(0.004)**	0.010(0.004)***
υ_2	0.009(0.003)***	0.008(0.003)***	0.009(0.003)***
ω_1	0.031(0.014)**	0.030(0.011)***	0.031(0.011)***
ω_2	0.017(0.011)	0.017(0.008)**	0.018(0.008)**
ξ_1	0.001(0.001)	0.002(0.001)*	0.002(0.001)*
ξ_2	0.002(0.003)	0.003(0.002)	0.003(0.002)
α	-0.068(0.048)	-0.048(0.033)	-0.053(0.033)
Hansen test	0.906	0.609	0.711
AR(1)/AR(2)	0.086/0.419	0.073/0.261	0.078/0.173

Table 5: Monetary policy, bank competition and bank characteristics

estimate	L1	L2	L3
β	-0.067(0.034)**	-0.086(0.043)**	-0.086(0.042)**
γ_1	-0.075(0.078)	-0.051(0.069)	-0.044(0.071)

γ_2	-0.082(0.036)**	-0.114(0.030)***	-0.101(0.031)***
ϕ	0.345(0.139)**	0.349(0.113)***	0.397(0.133)***
η_1	0.080(0.125)	0.030(0.120)	0.028(0.116)
η_2	0.166(0.091)*	0.210(0.072)***	0.216(0.079)***
λ	-0.093(0.049)*	-0.871(0.053)*	-0.119(0.068)*
ρ	2.628(0.985)***	1.871(0.904)**	2.332(1.072)**
δ	0.255(0.252)	0.180(0.163)	0.225(0.181)
σ_1	-0.004(0.023)	0.004(0.022)	0.006(0.021)
σ_2	-0.012(0.014)	-0.018(0.012)	-0.022(0.013)*
τ_1	-0.285(0.384)	-0.375(0.416)	-0.305(0.377)
τ_2	0.339(0.169)**	0.390(0.186)**	0.257(0.187)
ς_1	-0.513(0.385)	-0.727(0.375)*	-0.685(0.340)*
ς_2	0.206(0.130)	0.222(0.140)	0.148(0.138)
υ_1	0.010(0.005)*	0.008(0.005)	0.008(0.005)*
υ_2	0.007(0.004)*	0.005(0.003)*	0.005(0.003)*
ω_1	0.016(0.014)	0.0142(0.011)	0.010(0.012)
ω_2	0.009(0.012)	0.010(0.009)	0.005(0.010)
ξ_1	0.001(0.001)	0.002(0.001)	0.001(0.001)
ξ_2	0.001(0.002)	0.002(0.002)	0.001(0.002)
α	-0.204(0.105)*	-0.196(0.086)**	-0.212(0.089)**
Hansen test	0.998	0.997	0.990
AR(1)/AR(2)	0.004/0.327	0.007/0.394	0.004/0.373

Table 6: Monetary policy, bank competition and H-H index

estimate	L1	L2	L3
β	-0.124(0.054)***	-0.123(0.053)**	-0.106(0.059)*
γ_1	-10.77(3.123)***	-9.306(3.238)***	-9.064(3.345)***
γ_2	4.241(3.591)	2.161(3.776)	2.296(3.942)
ϕ	18.31(7.498)**	19.48(7.181)***	20.24(7.669)***
η_1	187.1(53.16)***	162.1(55.08)***	157.9(56.82)***
η_2	-72.31(61.21)	-36.79(64.32)	-39.18(67.09)
λ	0.001(0.030)	-0.002(0.039)	-0.005(0.038)
ρ	2.280(0.646)***	2.369(0.763)***	2.468(0.782)***
δ	0.080(0.181)	0.020(0.149)	0.016(0.163)
υ_1	0.021(0.011)*	0.016(0.012)	0.016(0.013)
υ_2	0.006(0.005)	0.004(0.005)	0.004(0.005)

ω_1	-0.016(0.013)	-0.019(0.013)	-0.019(0.014)
ω_2	0.017(0.020)	0.010(0.020)	0.010(0.021)
ξ_1	0.005(0.002)***	0.005(0.002)***	0.005(0.002)***
ξ_2	-0.005(0.003)**	-0.003(0.003)	-0.004(0.003)
α	-1.002(0.398)**	-1.037(0.376)***	-1.079(0.395)***
Hansen test	0.534	0.592	0.489
AR(1)/AR(2)	0.061/0.783	0.054/0.954	0.051/0.934

Table 7: Monetary policy, bank competition and CR3

estimate	L1	L2	L3
β	-0.115(0.057)**	-0.112(0.056)**	-0.104(0.062)*
γ_1	-5.079(1.980)***	-4.790(2.073)**	-4.483(2.090)**
γ_2	3.900(2.510)	3.658(2.536)	3.743(2.477)
ϕ	2.181(1.211)*	2.527(1.155)**	2.730(1.225)**
η_1	17.96(6.873)***	16.92(7.200)**	15.82(7.249)**
η_2	-13.81(8.780)	-12.99(8.862)	-13.31(8.646)
λ	-0.007(0.030)	-0.019(0.041)	-0.023(0.042)
ρ	2.383(0.559)***	2.410(0.764)***	2.470(0.774)***
δ	0.075(0.209)	-0.001(0.170)	-0.014(0.181)
υ_1	0.012(0.009)	0.010(0.009)	0.009(0.009)
υ_2	0.006(0.003)*	0.005(0.003)*	0.005(0.004)
ω_1	-0.006(0.013)	-0.007(0.130)	-0.007(0.013)
ω_2	0.017(0.018)	0.018(0.018)	0.018(0.018)
ξ_1	0.002(0.001)	0.002(0.001)*	0.002(0.002)
ξ_2	-0.005(0.002)**	-0.004(0.003)*	-0.004(0.002)**
α	-0.575(0.311)*	-0.659(0.299)**	-0.711(0.311)**
Hansen test	0.683	0.518	0.571
AR(1)/AR(2)	0.067/0.864	0.061/0.871	0.061/0.936

Table 8: Monetary policy, bank competition and CR5

estimate	L1	L2	L3
β	-0.111(0.057)*	-0.110(0.057)*	-0.101(0.062)
γ_1	-8.293(2.569)***	-7.717(2.655)***	-7.260(2.700)***
γ_2	2.404(3.066)	1.364(3.111)	1.310(3.181)
ϕ	1.941(1.047)*	2.205(0.992)**	2.374(1.045)**
η_1	20.02(6.080)***	18.65(6.287)***	17.55(6.383)***

η_2	-5.723(7.257)	-3.260(7.365)	-3.143(7.521)
λ	-0.009(0.030)	-0.021(0.041)	-0.025(0.041)
ρ	2.399(0.560)***	2.414(0.766)***	2.477(0.778)***
δ	0.079(0.214)	-0.001(0.173)	-0.013(0.184)
υ_1	0.015(0.010)	0.126(0.010)	0.012(0.010)
υ_2	0.004(0.003)	0.003(0.003)	0.003(0.003)
ω_1	-0.022(0.013)*	-0.024(0.013)*	-0.024(0.013)*
ω_2	0.008(0.019)	0.003(0.003)	0.004(0.019)
ξ_1	0.004(0.001)***	0.005(0.002)***	0.004(0.001)***
ξ_2	-0.005(0.003)*	-0.004(0.003)	-0.004(0.003)
α	-0.729(0.391)*	-0.818(0.372)**	-0.880(0.385)**
Hansen test	0.645	0.553	0.540
AR(1)/AR(2)	0.069/0.889	0.062/0.852	0.062/0.960

Table 9: Monetary policy, bank competition, bank characteristics and H-H index

estimate	L1	L2	L3
β	-0.150(0.056)***	-0.149(0.044)***	-0.140(0.049)***
γ_1	-11.37(3.321)***	-9.955(3.424)***	-9.717(3.519)***
γ_2	2.833(3.630)	0.507(3.967)	0.551(4.108)
ϕ	20.25(7.594)***	21.62(7.384)***	22.81(7.802)***
η_1	198.4(57.04)***	174.5(58.67)***	170.3(60.21)***
η_2	-47.96(61.94)	-8.195(67.67)	-9.023(70.02)
λ	0.005(0.031)	0.003(0.039)	-0.003(0.038)
ρ	2.248(0.670)***	2.342(0.800)***	2.355(0.839)***
δ	-0.060(0.230)	-0.156(0.210)	-0.167(0.213)
σ_1	0.012(0.012)	0.013(0.011)	0.014(0.011)
σ_2	0.027(0.011)**	0.026(0.011)**	0.027(0.011)**
τ_1	-0.377(0.603)	-0.476(0.582)	-0.461(0.578)
τ_2	0.547(0.142)***	0.476(0.138)***	0.477(0.146)***
ς_1	-0.903(0.614)	-1.056(0.590)*	-1.067(0.588)*
ς_2	-0.109(0.168)	-0.190(0.153)	-0.168(0.152)
υ_1	0.019(0.011)*	0.013(0.012)	0.013(0.013)
υ_2	0.005(0.004)	0.002(0.004)	0.002(0.005)
ω_1	-0.020(0.013)	-0.023(0.014)*	-0.023(0.014)
ω_2	0.012(0.020)	0.004(0.020)	0.004(0.021)
ξ_1	0.006(0.002)***	0.006(0.002)***	0.006(0.002)***
ξ_2	-0.004(0.003)	-0.003(0.003)	-0.003(0.003)

α	-1.089(0.395)***	-1.127(0.375)***	-1.192(0.390)***
Hansen test	0.509	0.845	0.494
AR(1)/AR(2)	0.079/0.174	0.056/0.479	0.057/0.336

Table 10: Monetary policy, bank competition, bank characteristics and CR3

estimate	L1	L2	L3
β	-0.139(0.061)**	-0.135(0.047)***	-0.127(0.053)**
γ_1	-5.766(2.202)***	-5.547(2.196)**	-5.248(2.218)**
γ_2	3.428(2.562)	3.005(2.609)	3.120(2.532)
ϕ	2.251(1.199)*	2.506(1.104)**	2.708(1.193)**
η_1	20.52(7.709)***	19.75(7.671)***	18.68(7.740)**
η_2	-12.12(8.962)	-10.65(9.119)	-11.08(8.836)
λ	-0.004(0.033)	-0.012(0.042)	-0.016(0.042)
ρ	2.315(0.705)***	2.300(0.774)***	2.343(0.832)***
δ	-0.570(0.260)	-0.160(0.225)	-0.171(0.228)
σ_1	0.012(0.012)	0.012(0.010)	0.013(0.010)
σ_2	0.028(0.011)**	0.027(0.011)**	0.027(0.010)***
τ_1	-0.392(0.610)	-0.498(0.603)	-0.483(0.597)
τ_2	0.539(0.154)***	0.469(0.171)***	0.459(0.181)**
ς_1	-0.895(0.614)	-1.038(0.586)*	-1.050(0.585)*
ς_2	-0.107(0.148)	-0.175(0.143)	-0.153(0.142)
υ_1	0.011(0.009)	0.009(0.009)	0.009(0.010)
υ_2	0.006(0.003)*	0.005(0.003)	0.004(0.003)
ω_1	-0.007(0.013)	-0.009(0.013)	-0.009(0.013)
ω_2	0.017(0.018)	0.017(0.018)	0.017(0.018)
ξ_1	0.003(0.002)*	0.003(0.001)**	0.003(0.002)*
ξ_2	-0.004(0.002)**	-0.004(0.002)*	-0.004(0.002)*
α	-0.587(0.301)*	-0.645(0.274)**	-0.696(0.290)**
Hansen test	0.755	0.871	0.563
AR(1)/AR(2)	0.083/0.231	0.058/0.620	0.059/0.437

Table 11: Monetary policy, bank competition, bank characteristcis and CR5

estimate	L1	L2	L3
β	-0.136(0.061)***	-0.133(0.047)***	-0.125(0.053)**
γ_1	-9.358(2.992)***	-8.940(2.926)***	-8.492(2.975)***
γ_2	1.206(3.374)	-0.027(3.500)	-0.038(3.557)

ϕ	1.943(1.015)*	2.115(0.921)**	2.285(0.990)**
η_1	22.69(7.145)***	21.71(6.975)***	20.63(7.078)***
η_2	-2.830(8.003)	0.105(8.305)	0.116(8.427)
λ	-0.005(0.032)	-0.013(0.042)	-0.017(0.042)
ρ	2.324(0.706)***	2.305(0.777)***	2.349(0.837)
δ	-0.051(0.265)	-0.157(0.227)	-0.168(0.231)
σ_1	0.011(0.012)	0.012(0.010)	0.013(0.010)
σ_2	0.028(0.011)**	0.027(0.011)**	0.027(0.010)***
τ_1	-0.398(0.069)	-0.502(0.602)	-0.488(0.596)
τ_2	0.538(0.153)***	0.466(0.172)***	0.455(0.183)**
ς_1	-0.889(0.615)	-1.032(0.587)*	-1.044(0.585)*
ς_2	-0.104(0.148)	-0.172(0.143)	-0.150(0.142)
υ_1	0.015(0.010)	0.012(0.010)	0.012(0.011)
υ_2	0.004(0.003)	0.002(0.003)	0.002(0.004)
ω_1	-0.026(0.014)*	-0.029(0.014)**	-0.029(0.014)**
ω_2	0.004(0.020)	0.001(0.019)	0.001(0.020)
ξ_1	0.005(0.002)***	0.005(0.002)***	0.005(0.002)***
ξ_2	-0.004(0.003)	-0.003(0.003)	-0.003(0.003)
α	-0.715(0.371)*	-0.765(0.334)**	-0.829(0.352)**
Hansen test	0.741	0.776	0.596
AR(1)/AR(2)	0.085/0.249	0.058/0.642	0.059/0.458

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The Impact of Mobile Financial Services (MFS) to the Economic Development of Emerging Economy

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Abstract
The study aims to explore the research questions and tries to find out how many Mobile financial services have contributed to our rural economic development in Bangladesh. The research type is exploratory and followed by a conclusive method. A total of 100 MFS users were taken for the study. The study's findings revealed that MFSs contribute to individual households, small and medium businesses, and farmers but that is not at a very significant level. Rural people are using MFSs only for money transfer services and remittance purposes. Other services like savings, insurance, access to loans, and mobile banking have not been used that much, and many rural people don't even know about these services due to a lack of knowledge and education. The study also showed that MFSs have increased income, improved living standards, Job creation, poverty alleviation, women empowerment, breakdown of the power of middlemen, and so on. However rural populations have faced some problems and challenges with MFSs. Based on these findings, the study suggested that MFS operators should build a strong security system to moderate the transaction cost and arrange more campaigns regarding Digital and Financial literacy programs in rural areas. So, the risk associated with MFSs should be reduced and then MFS may prove as one of the finest innovations in our developing country.

Keywords: MFSs, Rural People, Economic Development, Rural Business, OLS

1. Introduction

Bangladesh is the most densely populated country in the world. Despite facing all obstacles, the country is making significant progress in its economy. But still, the country faces challenges that may hinder economic growth, especially in rural areas. According to the World Bank report, almost 61% of people live in rural areas and most of them do not have any bank account. Access to financial services has become one of the major roadblocks to our economic development. To bring the huge population under the banking system is quite impossible. Establishing branches and serving the marginalized and rural people in remote areas is not cost-effective for the banks. Mobile financial services are one of the finest innovations of the modern financial system that has been applied to connect unbanked and underprivileged people into formal financial channels. Now the impact of mobile financial services on our economy is enormous. However, the emergence of mobile financial services (MFS) has brought a major revolution in the financial landscape in Bangladesh and has created new opportunities for the people, particularly for the unbanked and unserved people in rural areas. Now it has evolved into the lifeline for rural people who have

limited access to the formal banking channel. MFS is the mobile technology that provides electronic monetary services by allowing users to access financial services through their mobile phones. Users can easily access banking services as well as other financial-based transactions by using their phones.

Mainly, mobile financial service is divided into mobile payment and mobile banking. The rapid growth of MFS is only possible due to the Digitalization of payment systems, the rapid growth of mobile phone users, strong IT infrastructure, country-wide network coverage, and availability of the internet all over the country have enhanced the likelihood of financial inclusion through MFSs. Bangladesh is moving to a digital economy with the help of MFS. Since its inception in 2011, Bangladesh has gained robust growth in the number of account holders and number of transactions in MFS due to the rapid increase in mobile phone users. MFS has made itself indispensable which is blissful for the underprivileged people. By increasing popularity and accessibility, rural people have used the MFS as the primary mode of financial transaction which is recognized as the potential catalyst for rural economic development. To fulfill the goal of financial inclusion, MFS has played a remarkable role in flourishing rural economic development by providing access to savings, credit, insurance, and other financial services for the unbanked and underprivileged people of our country. This success has led to an increase in job creation, women empowerment, and financial literacy which has boosted the living standard of the rural people. However, many rural people are still confined to only money transfer services, and a very significant percentage of people, particularly women open MFS only for inward remittance. Moreover, Access to other services by rural people is still quite harder for them. Still, other services like savings, access to loans, and insurance are little meaningful for them. Suppose if farmers and small and medium businesses can access loans at their peak times through MFS they can contribute more to our economy. Because it's hard for them to get loans from banks due to strict terms and conditions and even some of them don't have any bank accounts. There are some problems and challenges that rural people face in dealing with MFSs.

2. Literature Review

Hossain and Russel (2017) showed that Mobile financial services have played a tremendous role in socio-economic development by serving unbanked and underprivileged people in rural areas in which bKash has held the lead position of the market. The study revealed that bKash has created a positive impact on socio-economic development by creating women empowerment, reducing poverty, encouraging saving, an easy way to receive foreign remittances, helping to develop the SMEs and agricultural sector, and breaking down the exploitation of middlemen and flourishing business transactions. Ultimately this positive impact has uplifted the living standard of the rural people.

Akhter and Khalily (2017) investigated the impact of mobile financial services on financial inclusion in Bangladesh. Mobile financial services have come up with a major `change in the institutional structure and financial products. The outcome of the paper stated that the need for mobile financial services is indispensable. It can stretch out the excluded low-income, small, and medium enterprises which will have a wider impact on poverty alleviation and growth.

Islam, Basher, and Haque (2022) asked in the study whether mobile financial services can help elevate people out of poverty. The study examined the impact of mobile financial services on poverty reduction at the district level throughout 2010-2016 in Bangladesh and found out that 0.71%-point poverty is reduced due to every one billion takas increased through bKash. The study suggested that mobile money has become the lifeline for poor people who have limited access to the formal banking sector and has been successful in accomplishing various policies regarding poverty reduction initiatives

Kumar (2021) presented an overview of the prospects and challenges of MFS that may focus on some development strategies for policyholders in Bangladesh and described how MFS operators overcome MFS-related problems and challenges and satisfy their customers. The result of the study suggested that maintaining proper quality services, financial and technological risk, and the ability to provide appropriate services are the crucial challenges for Mobile financial services and recommended the MFS authorities open up a new path for the researcher to investigate in long-term nature

Rahman (2021) investigated the challenges that rural people may face difficulties during the use of mobile financial services in Bangladesh. The findings of the study suggested that a lack of proper knowledge and awareness, high transaction costs, and technological error are the challenges for rural users. Ultimately these challenges may extremely affect the actual users of the MFS. The government and the MFS authorities should take the appropriate steps and policies to reduce the risk associated with the MFS and ensure better quality services

Parlasca, Johnen, and Quaim (2022) described in the study that Interest in mobile financial services has increased due to the rapid increase in mobile phones in rural areas and collected data to analyze the mobile payment, savings, and access to credit among farmers in Kenya. The study showed that more than 80% of the farmers use mobile phones whereas only 15% of farmers use innovation for agricultural-related payments. Less than 1% of the farmers use the mobile loan facility for their agricultural investments. Overall, the usage of the MFS in agriculture among farmers is assumed to be lower indicating that MFS may not have a transformative impact on farming in Kenya.

Kikulwe, Fischer, and Quaim (2014) did a study on farmers, and householders in Kenya and found out that the use of mobile money has a great impact on household income. Remittance received from friends, and family is one of the important pathways for reducing the risk and liquidity constraints, promoting the commercialization of agriculture. The result suggested that mobile money has helped to alleviate poverty reduction and overcome the people from obstacles that hindered them from accessing the market

Ouma, Odongo, and Were (2017) showed in the study that the adoption of the mobile phone has become instrumental for the unbanked segment populations to the mainstream financial systems in Africa and led to an increase in the usage of mobile financial services. The study revealed that mobile financial services have boosted the likelihood of savings at the household level. It has helped to promote saving mobilization among the poor and low-income level people who are excluded from formal banking activities.

Sarpong and Agbeko (2020) stated in their study that mobile financial services are one of the greatest innovations for the people of Ghana. It has extended its services all over. The study revealed that the people of Ghana have a lot of expectations and have some future desires like foreign exchange services, ATM transactions, online shopping, and online payment that must be furnished by the MFS

Alampay, Moshi, Ghosh, Peralta, and Harshanti (2017) did a systematic review to determine the impact of mobile financial services in low and lower-middle-income countries. The study showed that mobile financial service in developing countries is the medium for reaching unbanked people and giving them access to financial services. The findings of the study demonstrated that significantly mobile financial service users received higher volumes of remittances than nonusers. Even 54% in farm-inputs consumption was increased due to the use of MFS compared to non-users. The study also revealed that the contribution of MFS to household income and farm yield sold is significantly increased.

Vong, Fang, and Isu (2012) did a pilot study to assess the impact of mobile money services on micro-entrepreneurs in rural Cambodia. The pilot study suggested that mobile financial service has the potential ability to flourish the micro or small business trade in terms of minimizing the operational, higher profit margin, and access to the market and that helps to improve their living standards.

Morawczynski and Pickens (2009) presented an insightful understanding of how the use of M-PESA has impacted poor people and their lives and that was conducted in two communities: Kibera and Bukura in Kenya. The study demonstrated that M-PESA has reduced the barriers to money transfer helped to release money flow and allowed that flow to enter rural areas. Users transferred small amounts of money with greater frequency. Even remittance and saving patterns have changed significantly.

kirui, Okello, Nyikal, and Njiraini (2013) stated in their study that the impact of mobile phone-based money transfer services in the agriculture sector has significantly increased. The study demonstrated that by using mobile-

based money transfer services, farmers can resolve market failures that they faced earlier and now they can access financial services in the market.

Abdinoor and Mbamba (2017) presented an assessment of consumers' adoption of mobile financial services in Tanzania by using the technology acceptance model. The findings of the study revealed that the adoption of mobile financial services is positively related to individual awareness, perceived usefulness, and benefit. The study recommended that mobile service providers should play a leading role in influencing individual awareness and perception of mobile banking and consider the affordability and availability of financial services for low-income people in Tanzania.

Literature Gap: Following literature gap has been identified to construct the research questions and develop the relevant hypothesis considering the review of literature mentioned above.

This investigation will enable us to know whether MFSs have significant contribution to the rural business stakeholders including small and medium business owners and farmers accelerating the economic development of this country.

2.1 Research Question and Development of Hypothesis

Considering the literature gaps discussed earlier in literature review, following research questions have been developed:
(i)For what type of service, do individual households, small and medium business owners, and farmers use MFSs?
(ii)What are the usage patterns of MFSs on households, small and medium business owners, and farmers in Bangladesh?
(iii)What is the contribution of MFS to individual households, rural businesses, and farmers in Bangladesh?
(iv)What are the problems and challenges households, rural business owners and farmers are facing with MFSs?
Considering these research questions, following hypothesis has been constructed:
Hypothesis development:
H_0 (Null Hypothesis): MFSs don't have significant contribution to the rural business accelerating the economic development of a country.
H_1 (Alternative Hypothesis): MFSs have significant contribution to the rural business accelerating the economic development of a country.

3. Data and Methods

The study is based on a mixed methods approach where both qualitative and quantitative approaches are being used and has been conducted based on an exploratory approach by using primary data followed by the conclusive approach. Primary data was collected through a survey where a 5-point Likert scale questionnaire (1 is for Strongly Disagree to 5 is for Strongly Agree) was applied to assess the response of the participants. Both closed-ended and open-ended questions were used in this study. For conducting the study, a convenient sampling method was used. The survey was done among 100 rural people who were users of the mobile financial service at Suhilpur Union, Brahmanabaria in Bangladesh. The questionnaire is designed for all MFS users. Among all individual households, who were small and medium business owners and farmers were further asked to give their opinion on the 5-point Likert scale questions which were specially designed for them. Close-ended data collected through the survey was analyzed by statistical tools like descriptive statistics, and regression analysis, Pearson Correlation. For the analysis of the four open-ended questions, thematic analysis was used to identify the meaning or themes of the answers of the participants, and graphs were used to illustrate the thematic analysis's results. However, here multiple regression analysis is used to measure the impact of individual variables on a dependent variable.

Following regression model has been constructed:

$$\boldsymbol{Y_i = \alpha_i + \sum_{k=1}^{9} \beta_i X_{ik} + u_i} \dots\dots\dots\dots\dots (1)$$

Where,
Y= MFSs can contribute to the rural business
X_1 = Merchant mobile account can help you to increase your sales
X_2 =Your business operation is managed smoothly by using the MFSs
X_3 =Mobile financial services have increased the business profit
X_4 =MFSs have reduced costs and made business transactions easy
X_5 =MFSs have encouraged you to save and investment
X_6 =MFSs have offered mobile banking services
X_7 =MFSs have increased the financial productivity in seasonal times
X_8 =MFSs have created employment opportunities through your business in your rural areas
X_9 =MFSs have played the role to develop the SMEs
u_i=Error term
We have adopted OLS method[1] to estimate the coefficients of this regression model depicting the relationship between MFS's contributions and rural developments.

4. Results and Discussion

4.1. Mobile Financial Services and Individual Households

Table 1: Descriptive Analysis of the Individual Household's Questions

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
It's easy to receive foreign remittances through MFSs	100	3.00	5.00	4.8400	.39492
MFSs have increased the income level in your family	100	3.00	5.00	4.4800	.59425
MFSs have improved the living standard by accessing better goods and services for the rural people	100	3.00	5.00	4.5300	.57656
Save cost and time through MFSs	100	4.00	5.00	4.6200	.48783
MFSs have encouraged you to save	100	2.00	5.00	3.4200	.92310
MFSs have helped to reduce poverty in your family	100	1.00	5.00	3.8400	.95049
Now women in your family have operated MFSs independently	100	2.00	5.00	4.7700	.50960
Rural women are empowered to be involved in small-scale business	100	3.00	5.00	4.8500	.43519

[1] Steps in Deriving OLS Estimators: Defining the model and error term using this equation no.01; then **Define the sum of squared errors (SSE) followed by Minimizing the SSE using calculus; after that solving the normal equations, OLS estimators (including intercept and slope) can be obtained.**

Rural women have contributed to the family by accessing financial services	100	3.00	5.00	4.9200	.30748
MFSs are reliable, convenient, and safe for the rural people	100	4.00	5.00	4.9700	.17145
Valid N (listwise)	100				

Source: Field Survey (Analysis by SPSS)

Table 01 shows the descriptive statistical analysis of the statements that have been given to the respondents. To assess the response of the respondents regarding the statements, a 5-point Likert scale is applied in the field survey. Based on the perception of the respondents regarding the mean value of the statements, the decision will be taken. In the Likert scale, 1= Strongly Disagree, 2= Disagree, 3=Neutral, 4= Agree, 5=Strongly Agree.

The first statement shows the mean value is 4.84 which is almost 5. Here 5 indicates strongly agree. It means that the majority of the participants strongly agree with the statement that 'It is easy to receive foreign remittance through MFSs'.

The mean value of the second statement is 4.48. This shows most of the respondents agree with the statement that 'MFSs have increased the income level in their family'.

The third statement's mean value is 4.53 which refers to the agreed option (point 4). Rural people agree with the statement that MFSs have improved living standards by accessing better goods and services.

The fourth statement states that MFS has saved costs and time. The mean value of the statement is 4.62. Most of the respondents agree with this statement.

The Fifth statement states that MFSs have encouraged them to save. So the mean value of the statement is 3.42. It means that most of the respondents are neutral about the statement. They don't even know that MFSs have encouraged them to save.

In the sixth statement, we can see that the majority of the respondents agree with the statement that MFSs have helped to reduce poverty in their families. Here the mean value is 3.84 which is near to point 4 or agrees.

In the seventh statement, the mean value is 4.77 which is near to point 5. So, we can say that All respondents strongly agree with the statement that 'women in their family have operated MFSs independently.

The eighth statement's mean value is 4.85. So the majority of the respondents have chosen the strongly agree option. These rural people strongly agree that Rural women are empowered to be involved in small-scale business.

The ninth statement indicates that Rural women have contributed to their families by accessing financial services. By assessing the mean value of 4.92 of this statement, we can see that almost all the respondents strongly agree with the statement.

In the tenth statement, the mean value is 4.97. That is very close to point 5. There is no doubt that overall MFSs are reliable, convenient, and safer for rural people. The majority of the respondents strongly agree with this statement.

After assessing all the responses of the households, we can see that mobile financial service has a great impact on the rural economic development in Bangladesh.

Table 2: Correlation between increased income and poverty reduction in rural families through MFSs

		MFSs have increased the income level in your family	MFSs have helped to reduce poverty in your family
MFSs have increased the income level in your family	Pearson Correlation	1	.263**
	Sig. (2-tailed)		.008
	N	100	100
MFSs have helped to reduce poverty in your family	Pearson Correlation	.263**	1
	Sig. (2-tailed)	.008	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Field Survey (Analysis by SPSS)

The correlation of the coefficient of the two variables is .262. That indicates that the association between the increased income of rural people and poverty reduction in rural families has a small positive relation but the correlation is statistically significant.

Table 3: Correlation between increased income and improved living standards by accessing better goods and services in rural families through MFSs

		MFSs have increased the income level in your family	MFSs have improved the living standards by accessing better goods and services for rural people
MFSs have increased the income level in your family	Pearson Correlation	1	.282**
	Sig. (2-tailed)		.004
	N	100	100
MFSs have improved the living standard by accessing better goods and services for the rural people	Pearson Correlation	.282**	1
	Sig. (2-tailed)	.004	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Field Survey (Analysis by SPSS)

From table 03, we can see that the correlation between the two variables is .282 on a sample of 100. The correlation of the coefficient describes that there is a small positive association between increased income and improved living standards by accessing better goods and services to the rural people through the help of MFSs but the association between the variables is significant.

Table 4: Correlation between increased income and encouraged savings in rural families through MFSs

		MFSs have increased the income level in your family	MFSs have encouraged you to save
MFSs have increased the income level in your family	Pearson Correlation	1	.200*
	Sig. (2-tailed)		.046
	N	100	100
MFSs have encouraged you to save	Pearson Correlation	.200*	1
	Sig. (2-tailed)	.046	
	N	100	100

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Field Survey (Analysis by SPSS)

The correlation of the coefficient between the two variables is .200. That describes a very weak relationship between the increased income and encouragement for saving in rural families through MFSs. However, the association between the two variables is statistically significant.

4.2. Contribution of MFSs to Rural Small and Medium Businesses

Table 5: Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.843[a]	.711	.593	.15686

a. Predictors: (Constant)

Source: Field Survey (Analysis by SPSS)

From the model summary, we can see that the value of R is .843 or 84.3%. Here the value of R indicates that there is a high degree of strength among the independent and dependent variables.

Here R Square is .722. It means that 72.2% variation in the dependent variable is explained by the independent variables.

The value of the adjusted R^2 is .593 or 59.3%. The model indicates that 59.3% of predictor variables of MFSs are responsible for the contribution of the rural business.

Table 6: ANOVA

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.334[b]	9	.148	6.023	.000[b]
	Residual	.541	22	.025		
	Total	1.875	31			

a. Dependent Variable: Y

b. Predictors (Constant): X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9

Source: Field Survey (Analysis by SPSS)

From the ANOVA test, it is seen that level of significant value is less than 0.05 or 5% which indicates the null hypothesis is rejected and the alternative hypothesis is accepted. As a result, we can say that there is a significant relationship between independent variables and dependent variables. According to the result, the conclusion is that MFSs can contribute to rural business.

Table 7: Coefficients table

Model		Unstandardized Coefficients	Standardized Coefficients	t	Sig.
		B	Beta		
1	(Constant)	2.487*** (.0560)		4.444	.000
	Merchant mobile account can help you increase your sales	-.066 (.051)	-.198	-1.285	.212
	Your business operation is managed smoothly by using the MFSs	-.007 (.058)	-.020	-.127	.900
	Mobile financial services have increased the business profit	.015 (.037)	.053	.404	.690

MFSs have reduced costs and made business transactions easy	-.003 (.059)	-.007	-.058	.954
MFSs have encouraged you to save and investment	-.011 (.033)	-.043	-.336	.740
MFSs have offered mobile banking services	.186*** (.061)	.429	3.060	.006
MFSs have increased financial productivity in seasonal time	-.339*** (.1140)	-.508	-2.982	.007
MFSs have created employment opportunities through your business in your rural areas	.621*** (.117)	.848	5.322	.000
MFSs have played the role of developing SMEs	.100* (.055)	.233	1.823	.082

a. Dependent Variable: MFSs have the potential ability to contribute to the rural business
*Note: *, ** and *** indicate the level of significance of 10%, 5% and 1% respectively*
Source: Field Survey (Analysis by SPSS)

According to the table-06, the estimated multiple regression model is y (hat)= 2.487+(-.066)X1+(-.007)X2+(0.15)X3+ (-.003)X4+(-.011)X5+(.186)X6+(-.339)X7+(.621) X8+(.1)X9

4.3. Contribution of MFSs to Rural Farmers

Mobile financial services can contribute to the rural farmer by providing access to financial services. MFS has ensured financial inclusion in our country. No one is going to be left behind to include in the financial sector. That helps to fulfill the goal of SDGs.

1. Purchase agricultural stuff easily

The majority portion of farmers felt that MFSs have helped them to purchase agricultural stuff easily. They can easily send the money through their MFS account to the seller.

2. No need for middlemen to collect the payment

The majority of farmers strongly agree that there is no need for middlemen to collect the payment. There is no doubt that now farmer can receive their exact amount of money from selling products from their buyers in an MFS account. To get payment from the buyers, farmers need help from the middlemen to receive their money. A percentage of money has to be given to the middlemen to collect the money on behalf of farmers. Now the situation has changed and MFSs have come as the solution for the farmers. They do not need to bear additional costs to receive the money.

3. Reduced costs and saved time

MFS has broken down the power of middlemen in our society. There is no need for middlemen to settle the transactions between buyer and seller. This has reduced costs and saved time for the farmers. They are free from the exploitation of middlemen.

4. Access to financial services

Farmers are the most negligible person in our society. We can see in our study that all the farmers have up to primary level education. They do not have the proper education to accept the technology. Even it is quite hard for banks to connect all the people of the country. In the meantime, MFS has come up and resolved the problem. It

has tried that all the unbanked and unserved people of our society should connect to the financial system. Now financially excluded people can access financial services. The result of the study shows that the majority of the farmers can access financial services.

5. Access to loans

Access to loans is little meaningful for the farmer. Farmers are only introduced to the cash-in and Cash-out features of MFSs. They do not even know that other features like savings, access to loans, insurance, and donations are available. It would be a blessing for the farmers if they could access loans. Their contribution to our economy is unimaginable. Mobile operators should work more with farmers so that they can access all the services of MFSs at the lowest cost.

6. Improve the ability to save money

A very significant percentage of farmers are neutral and disagree with the statement that MFSs do not improve the ability to save money. They live from hand to mouth. It is hard for them to think about the savings.

7. Key barriers to adopting the MFS

Everyone agrees that lack of awareness, knowledge, and education are the key barriers to adopting the MFS. They don't have the financial literacy to operate the MFS. As a result, they get cheated by their relatives or agents. Many farmers said that MFS operators should arrange more campaigns to create awareness among people, build a strong security system, offer more incentives, and reduce transactional costs.

4.4. Response to Open-Ended Questions

Respondents have been asked to give their opinion on 'open-ended questions'. The answer to the questions is divided into a few categories after assessing a couple of responses.

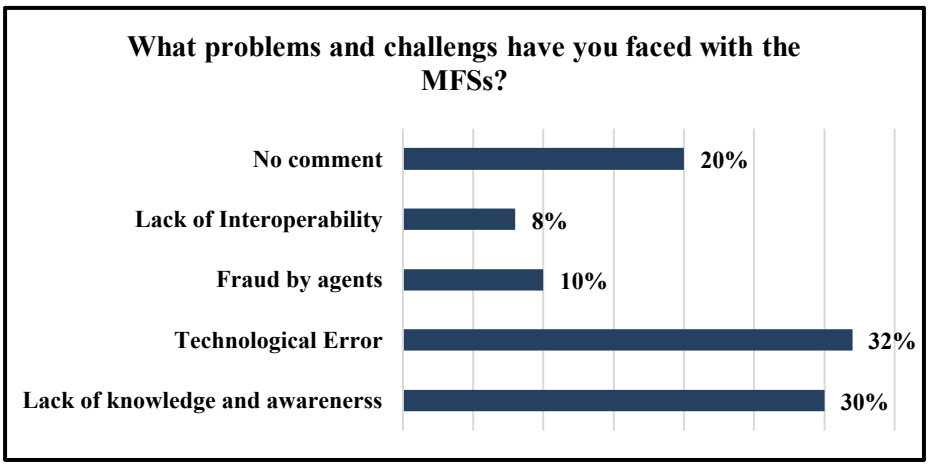


Figure 1: What problems and challenges have you faced with the MFSs?

Source: Field Survey (Analysis by SPSS)

The figure indicates that many of the respondents face technological errors while using the MFS. Rural people cannot make a transaction or sometimes it takes too much time to execute the transactions due to this error. Some of the respondents said that they cannot log in to the bKash app. One of the significant challenges faced by rural people is the lack of knowledge and awareness about MFS. 30% of the respondents said that they have insufficient knowledge to operate the MFS. Many rural people still think that MFS is only for Cash in and Cash out. 10% of the respondents got cheated by the agents. Even they got random calls and the fraudster told them to give the PIN. Another issue is that rural female users face harassment by male agents. Two respondents said that they got random

calls from unknown persons after the cashout. Another huge obstacle is the lack of interoperability among MFS providers. Users said that they could not send money among different MFS.

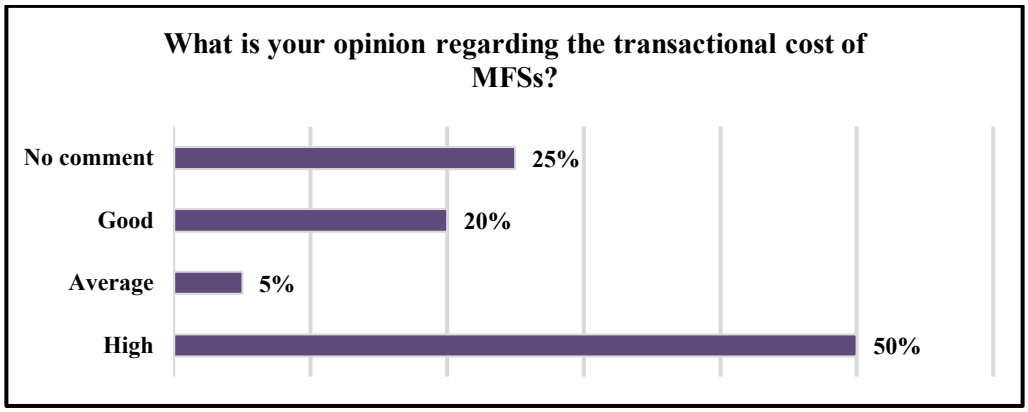


Figure 2: What is your opinion regarding the transactional cost of MFSs?

Source: Field Survey (Analysis by SPSS)

Figure 2 demonstrates the opinion of the respondents regarding the transactional cost of MFSs. The survey revealed that most of the respondents (50%) are unhappy with the higher transactional cost. Some of the respondents mentioned in the form that they are switching from bKash to Nagad due to high transactional costs. Even small and medium business owners said that high transactional cost is a huge burden for them. Sometimes they prefer not to use any MFS. 20% of them think that transactional cost is okay.

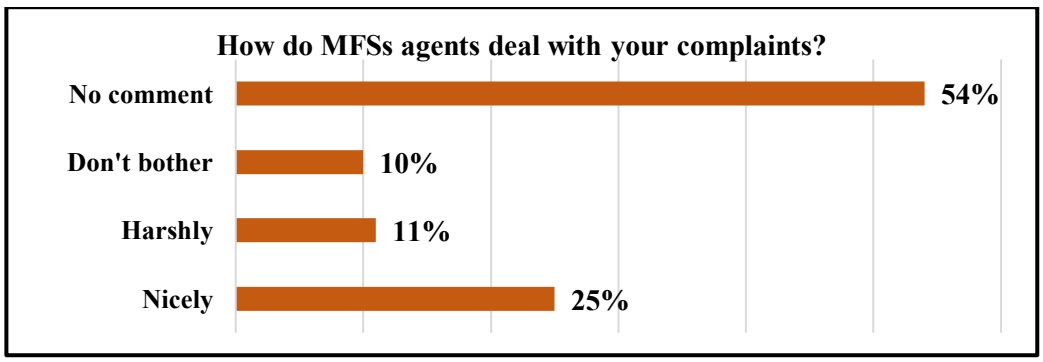
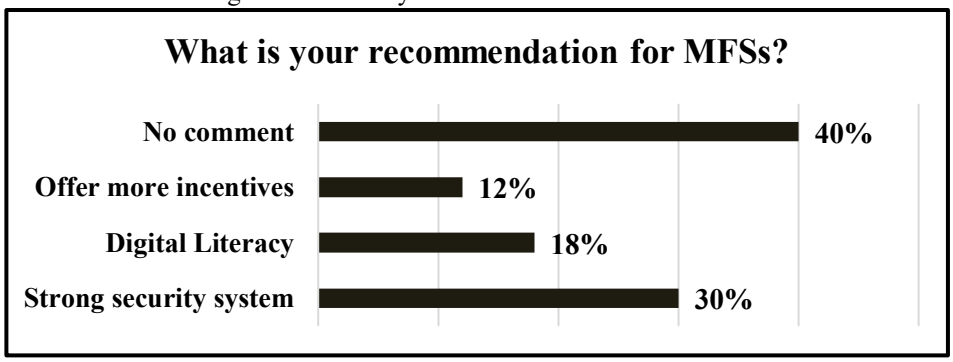


Figure 3: How do MFS agents deal with your complaints?

Source: Field Survey (Analysis by SPSS)

Figure 3 shows how MFS agents deal with respondents' complaints. 54% of them have no comment on this. Because they are okay with the services and don't find any issues. 25% of the respondents mention in the study that MFS agents deal with their complaints nicely and try to find any solutions immediately.

Figure 4: What is your recommendation for MFSs?



Source: Field Survey (Analysis by SPSS)

Figure 4 shows the recommendations for MFS. The survey states that a huge percentage of respondents have no comments. They don't even know what to suggest because of insufficient knowledge about the MFS. 30% of the respondents said that MFS should build a strong security system so that they may not get cheated by fraudsters. Due to numerous fraudulent activities, many people find it insecure to use the MFS. 18% of respondents said that MFS providers should create more campaigns regarding digital literacy so that rural people can gain sufficient knowledge to operate the MFS smoothly. People make more transactions when they get incentives from MFSs. Recently Nagad's BMW campaign has gained huge popularity. Many said they made more transactions in Nagad to win the BMW. The incentive is another motive to make people close to the MFS sector.

5. Conclusion with Policy Implications

Mobile financial services have played a remarkable role in flourishing the of rural economic development in Bangladesh. It is undoubtedly a fast-growing business. MFS is one of the finest innovations in mobile phone technology. It has ensured financial inclusion all over the country by including all the unbanked and unserved people in the financial service. The contribution of MFSs to our economy is enormous, especially in rural areas. It has reduced poverty and increased the income of rural families. It has improved the living standards of rural people by providing access to better goods and services and made daily life easier. It is quite unimaginable even a few years ago that rural women could receive money at home from their family members staying abroad. It has unleashed the door of opportunity for rural people. The study shows that MFS users are greater in rural areas than users in Urban areas. Now rural people are more willing to open MFS accounts to conduct their transactions smoothly. So mobile financial service operators should take effective measures to improve the quality of their services in rural areas and identify the difficulties that rural users face while using the MFS.

The study has explored the contribution of MFS to rural economic development in Bangladesh and tried to find out the problems and challenges that rural people face in operating the MFS. The study revealed that MFS has a contribution to individual households, small and medium businesses, and farmers. However, the contribution to the rural economy is not that significant. Rural people are still confined to mobile money transfers. Rural people are not introduced to other services of MFSs like savings, access to loans, insurance, and so on. However, the study also showed that MFSs have increased income, improved living standards, Job creation, poverty alleviation, women empowerment, breakdown of the power of middlemen, and so on in rural areas according to the responses of the participants. The study has demonstrated that rural people face difficulties while using the MFS. Due to technological errors, it takes a huge time to make transactions. Even they got cheated by agents and sometimes got random calls from fraudsters acting like MFS agents. The fraudster told them to give their PINs. Many users give their PINs. Because they do not have the proper knowledge of MFS. Even they are unhappy with the transaction cost and mention in the study that transactional cost is costly very for them.

Given these consequences, MFS operators should consider these issues build a strong security system moderate the transaction cost, and arrange more campaigns regarding digital and financial literacy programs in rural areas so that rural people can access more mobile transactions and prevent themselves from fraudulent activities. Clear rules of conduct should be ensured by the MFS operators to ensure that MFS agents serve the customers with professionalism and frequent monitoring with stringent policies must be introduced to prevent any misconduct from the agents towards customers. More collaboration with Banks and Microfinance Institutions to accelerate the microloans and credit to help the farmers and small businesses and should introduce specialized financial products like microloans, insurance, and savings for them. By implementing all these, MFSs can contribute more to rural economic development and ensure financial inclusion all over the country. In this way, MFS may prove as one of the finest innovations in our developing country.

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Conflicts of Interest: The authors declare no conflict of interest.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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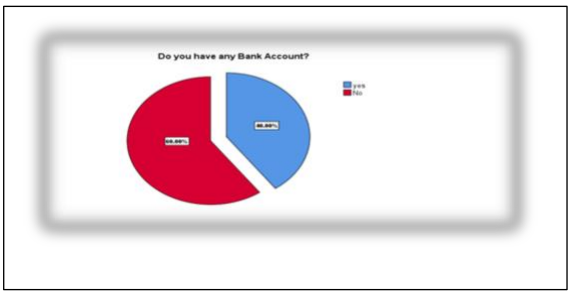
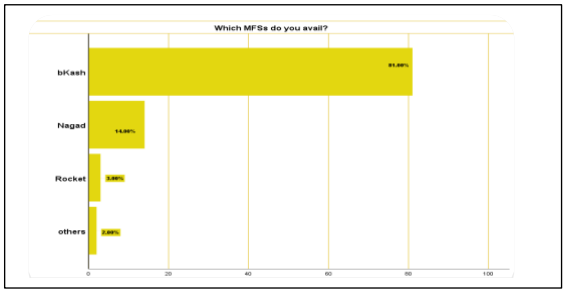
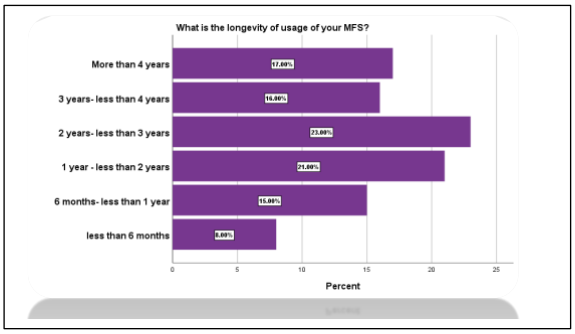
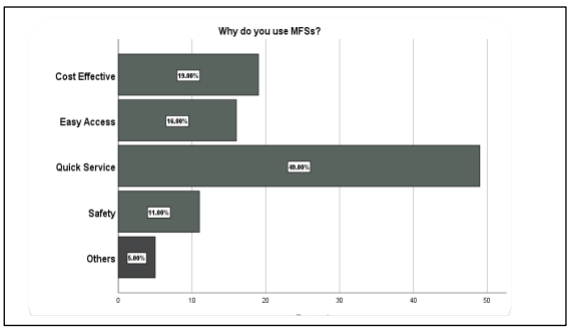
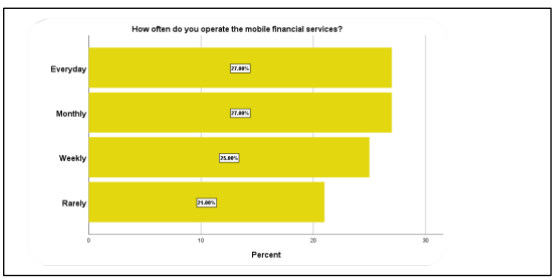
Appendix A

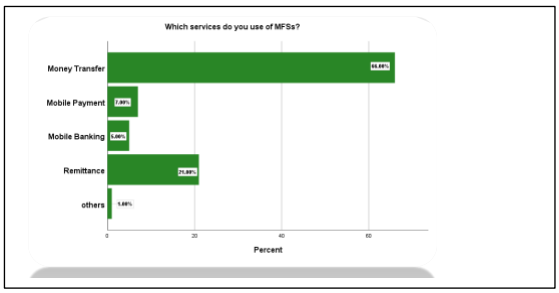

Do you have any Bank Account?
yes
No

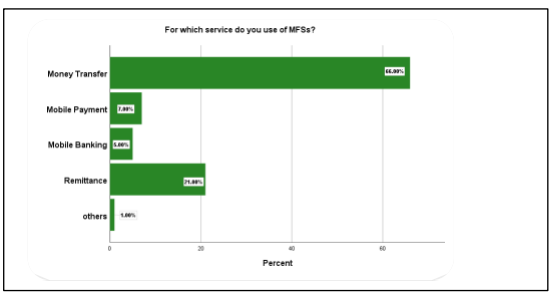

Which MFSs do you avail?
bKash
Nagad
Rocket
others

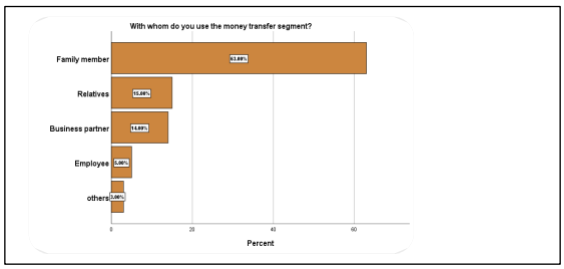

What is the longevity of usage of your MFS?
More than 4 years
3 years- less than 4 years
2 years- less than 3 years
1 year - less than 2 years
6 months- less than 1 year
less than 6 months
Percent

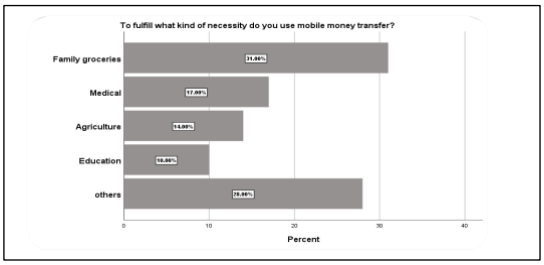

Why do you use MFSs?
Cost Effective
Easy Access
Quick Service
Safety
Others


How often do you operate the mobile financial services?
Everyday
Monthly
Weekly
Rarely
Percent


Which services do you use of MFSs?
Money Transfer
Mobile Payment
Mobile Banking
Remittance
others
Percent


For which service do you use of MFSs?
Money Transfer
Mobile Payment
Mobile Banking
Remittance
others
Percent


With whom do you use the money transfer segment?
Family member
Relatives
Business partner
Employee
others
Percent


To fulfill what kind of necessity do you use mobile money transfer?
Family groceries
Medical
Agriculture
Education
others
Percent

Appendix B

The Impact of Mobile Financial Services (MFS) to the Economic Development of Emerging Economy

The questionnaire is designed to capture the information about how mobile financial services have played a tremendous role in rural economic development by serving unbanked and underprivileged people. The survey will be conducted at Suhilpur Union, Brahmanabaria. Your response to this question will help me to achieve the desired goals. The survey question will be used only for research purpose. Thank you for your participation.

Section 1: General Information

1. Name of the Respondent (optional): ----------
2. Gender
   a. Male b. Female c. other
3. Age (years)
   a. Less than 20 b. 20-30 c. 31-40 d. 41-50 e. More than 50
4. Occupation
   a. Small and medium business b. Farming c. Housewife d. rickshaw puller e. Employee f. others
5. Marital Status
   a. Married b. Unmarried c. Others
6. Education Level
   a. Up to primary b. Up to SSC c. Up to HSC d. Up to graduation e. Others (specify)
7. Monthly Income
   a. less than 10000 b. 10000-19000 c. 20000-29000 d.30000- 39000 e. 40000 and above

Section 2: Usages of Mobile Financial Services

8. Do you have a Bank Account?
   a. Yes b. No
9. Which MFSs do you avail?
   a. bKash b. Nagad c. Rocket d. others
10. What is the longevity of usage of your MFS?
    a. less than 6 months
    b. 6 months - less than 1 year
    c. 1 year - less than 2 years
    d. 2 years - less than 3 years
    e. 3 years - less than 4 years
    f. more than 4 years
11. How often do you operate the mobile financial services?
    a. Everyday
    b. weekly
    c. monthly
    d. Rarely
    e. Never used

Section 3: Contribution of MFSs on Rural Economic Development

Question on Individual Household

(Type a)					
i) Why do you use MFSs?	ⓐ Easy Access	ⓑ Cost Effective	ⓒ Quick Service	ⓓ Safety	ⓔ others

ii) For service do you use of MFSs?	ⓐ Money Transfer	ⓑ Mobile Payment	ⓒ Mobile Banking	ⓓ Remittance	ⓔ others
iii) How do you operate MFSs?	ⓐ Self	ⓑ Family Members	ⓒ Friends	ⓓ Agent	ⓔ others
iv) To fulfill what kind of necessity do you use mobile money transfer?	ⓐ Family groceries	ⓑ Medical	ⓒ Agriculture	ⓓ Education	ⓔ others
v) With whom do you use the mobile transfer segment?	ⓐ Family Member	ⓑ Relatives	ⓒ Business Partner	ⓓ Employer	ⓔ others
(Type b)					
i) It's easy to receive foreign remittance through MFSs	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
ii) MFSs have increased the income level in your family	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iii) MFSs have improved the living standard by accessing better goods and services for the rural people	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iv) Save cost and time through MFSs	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
v) MFSs have encouraged you for savings	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vi) MFSs have helped to reduce poverty in your family	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vii) Now women in your family have operated MFSs independently	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
viii) Rural women are empowered to be involved in small-scale business	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
ix) Rural women have contributed to the family by accessing financial services	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
x) MFSs are reliable, convenient, and safe for the rural people	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree

14. **Part A: Question on Small and medium business owners (Answer these questions if you are a businessman or if not then, skip)**

i) Merchant mobile account can help you to increase your sales	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
ii) Your business operation is managed smoothly by using the MFSs	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iii) Mobile financial services have increased the business profit	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iv) MFSs have reduced costs and made business transactions easy	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
v) MFSs have encouraged you for savings and investment	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vii) MFSs have offered mobile banking services	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vi) MFSs have increased the financial productivity in seasonal time	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vii) MFSs have created employment opportunities through your business in your rural areas	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
viii) MFSs have played the role of developing the SMEs	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
ix) MFSs can contribute to the rural business	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree

14. **Part B: Question on Farmer (Answer these questions if you are a farmer or if not then, skip)**

i) MFSs have helped you to purchase the agricultural stuff easily	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
ii) There is no need for middlemen to collect the agricultural related payment	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iii) MFSs have reduced costs and saved time	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
iv) MFSs have helped you to access the financial services	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
v) MFSs have provided the access to loans	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vi) MFSs have improved the ability of rural farmers to save money	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree
vii) Lack of awareness, knowledge, and education are	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree

the key barriers to adopting the MFS					
viii) MFSs may have the potential ability to contribute to the rural farmers	ⓐ Strongly agree	ⓑ Agree	ⓒ Neutral	ⓓ Disagree	ⓔ Strongly disagree

15. What problems and challenges have you faced while using the MFSs?

_____

_____

16. What is your opinion regarding the transactional cost of MFSs?

_____

17. How do MFS agents deal with your complaints?

_____

18. What is your recommendation for MFSs

_____

_____

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Governing the Fairtrade Premium: A Case Study of Fairtrade Premium Decision-Making in Indonesia

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Abstract
Smallholder farmers are central to global agricultural supply chains, yet many continue to face structural barriers that limit their economic resilience and ability to engage in long-term sustainability efforts. Fairtrade certification—particularly through the Fairtrade Premium—is intended to help producer cooperatives invest in social, environmental, and organisational development. However, evidence shows that the effectiveness of the Premium varies widely, largely depending on a cooperative's internal governance capacity. This qualitative case study focuses on a Fairtrade-certified coffee cooperative in Indonesia that experienced governance crises, decertification, and later restructuring due to Premium mismanagement. Using interviews with farmers, delegates, board members, supervisory board members, and Premium Committee representatives, along with document analysis, the study explores how capacity gaps, financial pressures, and social expectations shape Premium decision-making. The findings show that although the cooperative's governance structure is democratic on paper, it operates in practice as a technocratic system in which those with greater information and procedural skill influence how funds are allocated. Decision-making is further shaped by uneven representation, transparency issues, and chronic financial stress. As a result, Premium allocations often prioritise short-term needs, while long-term investments—especially those related to sustainability and climate resilience—receive limited support due to immediate economic pressures and differing perceptions of risk. Although leadership has taken steps to rebuild legitimacy after past crises, underlying vulnerabilities remain. The study concludes that improving decision literacy, strengthening transparency, and fostering organisational learning are critical for realising the transformative potential of the Fairtrade Premium.

Keywords: Cooperative Governance, Decision-Making Processes, Fairtrade Premium, Smallholder Farmers

1. Introduction

Global agrifood systems are experiencing growing scrutiny due to their environmental fragility, social inequities, and the persistent vulnerability of smallholder farmers. Arulingam *et al.*, (2022) similarly argues that small-scale producers remain structurally constrained within global agrifood transformations, as widening sustainability demands often outpace the support available to farmers to adapt. Although small-scale producers contribute significantly to global food supply, they continue to face interlocking constraints related to low incomes, limited access to services, and structurally unequal market relationships. As industrial agriculture expands, sustainability

gaps widen, making it increasingly challenging for farmers to maintain livelihoods while complying with evolving market standards.

In response, voluntary sustainability standards such as Fairtrade have gained prominence as mechanisms to improve producer welfare, enhance bargaining power, and strengthen community development. Loconto *et al.*, (2021) show that Fairtrade's governance model is embedded within a broader socio-technical imaginary that relies on standards to organise responsibilities, participation, and accountability within producer organisations. Fairtrade's model operates through two core instruments: the guaranteed minimum price and the Fairtrade Premium, a collective development fund decided democratically by members of Small Producer Organizations (SPOs). The Premium is intended to finance long-term socio-economic and environmental improvements, such as training, infrastructure, organisational strengthening, risk management, and quality enhancement.

However, Fairtrade's actual impact varies considerably across contexts. Recent evidence mapping also highlights wide variation in Premium effectiveness across SPOs, largely influenced by governance capacity and participation Jodrell and de Bruin (2025). Research increasingly shows that the effectiveness of the Fairtrade Premium depends not only on market access but also on the internal governance capacity of cooperatives, the distribution of decision-making power, transparency, and the alignment of collective priorities (Loconto *et al.*, 2021). Cook (2018) emphasises that cooperatives frequently face control-rights and information problems arising from ill-defined property rights. Issues such as agency costs, influence activities, and information asymmetries shape decision outcomes and can increase ownership costs, thereby affecting organizational effectiveness.

This study focuses on a Fairtrade-certified coffee cooperative in Indonesia—referred to pseudonymously as the Kopi Coffee Cooperative—which experienced a severe governance crisis, lost its certification due to Premium mismanagement, and later underwent restructuring followed by recertification. This turbulent history provides a unique opportunity to examine how governance processes shape Premium decisions and how cooperatives recover from credibility challenges. Comparable dynamics are observed in other Fairtrade-certified producer organisations, where organisational restructuring and revised decision-making processes have been required to strengthen accountability and participation (Loconto *et al.*, 2021).

The cooperative consists of over 1,000 members, represented by delegates who formally serve as the highest decision-making authority through the General Meeting (GM). Additional governance actors include the Supervisory Board, the Executive Board, and the Premium Committee, each with distinct roles defined in statutes and Fairtrade requirements.

Preliminary observations and interviews reveal that despite having a formal democratic structure, actual decision-making is significantly shaped by capacity constraints, uneven literacy levels, informational asymmetries, and the influence of commercial actors such as collectors. Delegates, while normatively positioned as the "owners" of the cooperative, often lack the knowledge, confidence, and procedural literacy needed to engage effectively in budgeting or strategic planning. As Simon's (1972) explains, when individuals face complex decisions under limited information, they tend to satisfice—accepting proposals that appear adequate rather than analysing all alternatives. Supervisory Board members likewise struggle with unclear mandates and limited access to information, weakening oversight. This aligns with Simon's (1972) argument that real-world decision-makers operate under bounded rationality, constrained by limited information, cognitive capacity, and time. These gaps create conditions where Premium allocations tend to prioritise short-term tangible goods, such as household necessities or farming tools, over long-term resilience investments.

Further complicating matters are external pressures such as the EU Deforestation Regulation (EUDR), environmental degradation, market dependency, and financial instability. Chronic liquidity shortages and reliance on a single buyer constrain strategic decision-making, often turning the Fairtrade Premium into a de facto liquidity buffer rather than a development fund. These realities raise questions about the cooperative's ability to balance immediate member needs with strategic investment, manage risk, and maintain governance legitimacy.

- Against this backdrop, the study addresses five central questions:
- How is the Fairtrade Premium allocated within the cooperative?

- How do allocation decisions reflect trade-offs between short-term benefits and long-term investments?
- How do cooperative actors interpret sustainability and risk, particularly regarding climate and market volatility?
- How do different actor groups justify Premium decisions?
- How do governance structures and processes shape Premium outcomes?

By addressing these questions, the article contributes to scholarship on cooperative governance, smallholder sustainability, and development standards, offering insights into how democratic ideals meet practical constraints in organisational contexts. These findings resonate with global trends documented by Jodrell and de Bruin (2025), who show that Premium effectiveness is strongly mediated by governance capacity, participation, and transparency.

2. Methods

2.1 Research Design

This study employs a qualitative single-case study design to examine the internal governance dynamics of a Fairtrade-certified coffee cooperative in Indonesia. This approach is appropriate because the research seeks to understand complex social processes, specifically, how governance structures, decision-making routines, and actor interpretations shape Fairtrade Premium allocation. The selected cooperative presents a unique case because it experienced governance crises, decertification, and subsequent restructuring. These events create a rich empirical setting to examine how cooperatives rebuild legitimacy and negotiate organisational change following institutional failure.

2.2 Units of Analysis

The case study incorporates embedded units of analysis, including farmer members, village delegates, the Executive Board, the Supervisory Board, and the Premium Committee. This structure allows exploration of the interactions and misalignments between actors positioned at different layers of the governance architecture. The study situates their narratives within the procedural requirements of Fairtrade, thereby illustrating how global sustainability standards translate into everyday decision-making. This multilayered structure reflects what Cornforth (2004) identifies as inherent role ambiguity in cooperative governance systems.

2.3 Data Collection

Twelve semi-structured interviews were conducted in Bahasa Indonesia, lasting 90–120 minutes. Interviewees represented all governance units. Interviews explored understanding of the Fairtrade Premium, perceptions of roles, participation in GM and Pre-GM processes, views on transparency and accountability, interpretations of sustainability and climate risks, and Premium allocation priorities.
Document review included Fairtrade Development Plans (FDPs), GM minutes, statutes, Premium Committee proposals, and audit reports.

2.4 Data Analysis

Data analysis combined:

- Thematic analysis, to identify recurring governance patterns.
- Narrative analysis, to explore how actors justify decisions and construct meaning.
- System-thinking synthesis, which identified five reinforcing loops: low decision capacity, transparency–trust cycles, short-term preference dynamics, buyer dependency pressures, and climate-risk normalisation.

3. Results

3.1 Governance Architecture, Authority, and Decision Dynamics

The cooperative's governance architecture reflects a layered system in which statutes assign formal authority to member bodies such as the General Assembly and elected boards, yet real authority frequently lies with professional managers who initiate and implement decisions. As shown by Chaddad and Iliopoulos (2013) cooperatives allocate control rights between decision control and decision management, and this separation—combined with information asymmetries and increasing organizational complexity—enables managers to shape decisions before members exercise their formal approval powers.

A board member illustrates this structural imbalance by noting that the cooperative effectively "stands on two legs": the delegates and the collectors. While "the collectors are skilled in business, the delegates are not," he explained (Irwansyah Dika, Board).

Although collectors have no formal role in governance, they exert substantial influence through their control of procurement, cash flow, and everyday relations with farmers. Delegates, by contrast, face significant capacity limitations. Their uneven literacy and limited confidence in public speaking constrain their ability to represent members. As another board member described, "Among the 50 delegates, not all have the same level of knowledge, and not all can speak in meetings" (Fahrul Rizqan, Board).

This imbalance produces voice dominance, where decisions are shaped less by collective deliberation and more by whoever speaks the loudest. As the board member recalled, "Not all delegates are able to speak… in the end there is no voting, and decisions follow the strongest voice" (Fahrul Rizqan, Board).

3.1.1 Pre-GM as Agenda-Setting, Not Consultation

Although the Pre-GM is framed as a democratic forum for reviewing village proposals, interviews show that it functions mainly as an agenda-setting and filtering stage. Proposals are screened according to cost, strategic relevance, and whether they introduce something new. As one board member explained, the criteria begin with budget considerations, and if last year's activity was basic-goods distribution, this year they look for a different activity (Fahrul Rizqan, Board). This process concentrates decision authority in managerial hands and limits delegates' ability to meaningfully challenge proposals.

3.1.2 GM as Ratification Rather Than Decision-Making

By the time proposals reach the GM, the Fairtrade Development Plan (FDP) is already close to final. A board member noted that the FDP essentially takes shape in the Pre-GM, complete with preliminary figures, and the GM simply reviews and formalizes it (Fahrul Rizqan, Board).

Delegates rarely alter the structure; instead, they endorse what has been prepared. Despite claims of majority rule, formal voting almost never occurs. Another board member recalled that decisions are not made through voting but follow the loudest or most assertive voices (Fahrul Rizqan, Board).

A significant structural gap also emerged: delegates did not know that Fairtrade Standards require them to approve the entire Premium budget. In practice, they only discuss the portion shown to them, while major expenditures—such as operational costs or buyer-initiated programs—enter the FDP without their scrutiny. This produces a governance pattern that appears participatory but is substantively pre-determined before reaching the GM.

Taken together, these dynamics reveal a governance system that is democratic in form yet technocratic and dominated by voice and agenda control in practice.

3.2 Role Clarity, Capacity Gaps, and Representation Weaknesses

3.2.1 Premium Committee: Low Clarity and Basic Understanding

Premium Committee members frequently describe their understanding as minimal. One member explained that, to her knowledge, the committee is simply "responsible for ensuring the Premium is realised" (Rahmawati Hanim, Premium Committee). Another noted that, even after a month in the role, she was "still confused," despite knowing the task was to ensure transparency in Premium spending (Halimah Safitri, Premium Committee).

3.2.2 Delegates: Limited Capacity to Represent Members
Delegates likewise face constraints in literacy, information access, and confidence, which weaken their ability to convey community needs. As one board member recalled from his own experience as a delegate, many had limited information and did not fully understand the cooperative (Fahrul Rizqan, Board).

This results in structurally weak representation, exacerbated by procedural ambiguity. This reflects (Cornforth's (2004) representation–expertise paradox, where democratic legitimacy requires broad participation, yet practical decision-making often depends on a smaller group with greater expertise.

3.2.3 Supervisory Board: Persistent Role Ambiguity

Supervisory Board members describe wanting to keep appropriate boundaries but remain unsure of their actual responsibilities. One member emphasised not overstepping management's role so "each unit stays in its proper lane" (Sulaiman Yusuf, Supervisory Board), yet they also acknowledged needing clearer guidance—indicating incomplete role socialisation.

3.2.4 Cumulative Effect: Weak Oversight and Managerial Dominance

These capacity gaps across governance units limit effective oversight and ultimately reinforce managerial control over decision processes.

3.2.5 System Patterns Shaping Premium Decisions

Combined, the governance structure and capacity constraints create several reinforcing feedback loops:

- Low-Capacity Loop: Limited decision literacy reduces delegates' ability to scrutinise information, strengthening managerial filtering.
- Transparency–Trust Loop: Irregular information flows erode trust, prompting selective disclosure and further weakening transparency.
- Short-Term Preference Loop: Expectations for annual, tangible benefits drive allocations toward short-term goods rather than long-term development.
- Market Dependency Loop: Reliance on a single buyer and chronic liquidity stress push the cooperative to use the Premium as operational support.
- Climate Adaptation Loop: Farmers' normalisation of climate shocks lowers the perceived urgency for environmental or resilience-oriented investments.

3.3 Short-Termism, Member Preferences, and Long-Term Planning Challenges

3.3.1 Members' Mental Model: Premium as Immediate Household Support

Farmers consistently understand the Fairtrade Premium as a direct, short-term benefit. One member described it simply as "like basic goods we receive—that's the benefit" (Sukri Hermansyah, Member). Such expectations anchor annual demands and make long-term or developmental investments politically difficult.

3.3.2 Leadership Efforts to Redirect Priorities

Board members express frustration that farmers repeatedly request tools or basic goods rather than longer-term investments. One explained that while leadership prefers developmental programs, farmers "want something distributed every year" (Fahrul Rizqan, Board). Efforts to introduce investment-oriented budgets often face resistance because these ideas "were never part of earlier plans" and therefore feel unfamiliar to members (Fahrul Rizqan, Board).

Altogather these narratives highlight how short-term expectations, representational pressures, and limited organisational learning reinforce a difficult-to-break cycle.

3.3.3 Divergent Interpretive Frames Across Actor Groups

Narrative analysis shows clear differences in how actors interpret the Premium:

- Farmers view it as a tangible entitlement and a source of short-term relief.
- Delegates emphasise majority-rule fairness but depend heavily on management for technical interpretation.
- Board members frame decisions in terms of strategy, risk, and organisational sustainability.
- Supervisory Board members focus on transparency issues and farmer distrust.

These contrasting frames explain why some proposals gain traction while others struggle to advance.

3.4. Financial Stress, Liquidity Constraints, and Buyer Dependency

The cooperative's governance issues are closely intertwined with its severe financial vulnerability.

3.4.1 Chronic Capital Shortage

Leaders repeatedly note that the cooperative operates with almost no working capital, often relying on personal funds and buyer pre-financing to stay afloat. One board member explained that they "depend on personal capital so the cooperative does not collapse" (Junaidi Rahman, Board).

3.4.2 Office Closure and Liquidity Crisis

In 2023–2024, liquidity fell so sharply that the cooperative temporarily locked its office due to the inability to pay rent, staff salaries, or audit fees (Junaidi Rahman, Board).

3.4.3 Premium Used as Emergency Cashflow

With cashflow frequently disrupted, the Fairtrade Premium becomes an emergency financial buffer. As one leader noted, "When cash flow is strained… if the Premium is not available, we switch to emergency measures" (Junaidi Rahman, Board).

3.4.4 Dependence on a Single Buyer

The cooperative's limited capital also prevents market diversification, creating dependency on one buyer and reinforcing financial fragility (Junaidi Rahman, Board).

Together, these financial pressures directly shape Premium allocation, pushing decisions toward low-risk, short-term spending and away from long-term development investments.

3.5 Transparency Deficits, Trust Dynamics, and Oversight Challenges

Transparency and trust are widely recognised as central concerns, yet they remain inconsistently practiced across the cooperative.

3.5.1 Members Learn Through Rumours, Not Systems

Members often receive only partial information about Premium activities. One member, for example, said he only knew about the distribution of basic goods, indicating that reporting mechanisms are incomplete (Sukri Hermansyah, Member).

3.5.2 Supervisory Board: Limited Access, Unclear Oversight

Supervisory Board members acknowledge the need to monitor management but also note that their access to information is limited and their oversight role remains insufficiently defined.

3.5.3 Historical Non-Transparency Shapes Present Trust

Trust deficits are further influenced by past governance failures. A board member recalled that the founders were removed due to "the non-transparency of the previous management" (Irwansyah Dika, Board). Although new practices have been introduced, rebuilding trust continues to be a gradual process.

3.6 Divergent Perceptions of Risk and Sustainability
Risk perceptions significantly influence Premium priorities.

3.6.1 Farmers Normalise Climate Impacts

Farmers rarely articulate climate as a pressing risk; adverse weather is seen as routine. Prospect theory helps explain why slow-moving risks such as climate change may be discounted relative to immediate household needs Kahneman and Tversky (1979).

3.6.2 Leadership vs. Member Risk Frames

Board members worry about EUDR, declining yields, and market volatility—risks not widely recognised by members. This mismatch limits support for long-term climate or sustainability investments.

3.7. Organisational Learning and Post-Crisis Adaptation
Despite persistent challenges, the cooperative shows signs of emerging organisational learning. Leadership has revised the bylaws to remove founder privileges, addressing past governance distortions, and board members report holding monthly evaluations to prevent a repeat of earlier collapses. Together, these steps signal efforts to address previous governance failures, although the consistency and institutionalisation of these practices remain uncertain.

4. Discussion

The findings of this study reveal a governance system that is structurally democratic yet practically constrained by capacity gaps, financial stress, divergent expectations, and informal power relations. These dynamics collectively shape how the cooperative interprets and allocates the Fairtrade Premium. Although Fairtrade certification assumes that democratic structures, such as delegate representation and General Meetings, can enable development-oriented decision-making, the empirical evidence from this case demonstrates that democratic form alone is insufficient for achieving Fairtrade's transformative aspirations. Instead, organisational capability, trust, transparency, and structural vulnerability significantly mediate the outcomes of Premium allocation.

4.1 Democratic Form vs. Technocratic Practice

The cooperative's governance structure positions delegates as the highest authority and the primary carriers of members' voices. In reality, however, decisions are strongly shaped by management actors who have greater literacy, contextual understanding, and procedural skill. Because many delegates struggle to speak confidently or analyse proposals, decisions often default to whoever speaks the loudest. As one board member put it, "The decision follows the strongest voice." This dynamic reflects Cornforth's (2004) description of the tension between democratic representation and the influence of expertise, as well as the broader control–support paradox in board–management relations.

Such dynamics illustrate how institutional rules are mediated by actor capacity. Even when processes such as the GM and Pre-GM are designed to be participatory, their effective use depends on actors' knowledge, literacy, and confidence. These narrative differences show how actors' sense-making processes mediate democratic structures, creating mismatches between formal authority and practical influence. Without deliberate capacity strengthening, formal democratic spaces risk becoming symbolic rather than substantive, reinforcing managerial gatekeeping. This structural blind spot further weakens democratic accountability by narrowing the decision space available to member representatives

The presence of these reinforcing loops indicates that Premium governance challenges are not isolated events but self-reinforcing system patterns. This raises important implications for Fairtrade's model, which assumes that governance structures can compensate for inequalities in member capacity. In practice, without structured investment in decision literacy, democratic processes are quickly overshadowed by informal hierarchies.

4.2 Short-Termism and the Social Meaning of the Premium

A central tension revealed in this study is the gap between Fairtrade's development-oriented intentions and how members themselves understand the Fairtrade Premium. For many farmers, Premium benefits are seen as immediate household support, "like basic necessities," as one member described. This interpretation is understandable: in conditions of economic insecurity, direct distributions offer tangible, visible returns from cooperative membership. These expectations are further reinforced by past practices in Fairtrade cooperatives, where tools and household items were regularly distributed.

Such short-termism is not merely a preference; it reflects structural vulnerability. Farmers experiencing seasonal income fluctuations, climate variability, and market volatility are inclined to prioritise immediate stability over uncertain long-term investments. This behavioural tendency is consistent with Kahneman and Tversky's (1979) description of the certainty effect, where individuals place disproportionate weight on outcomes that provide certain, immediate benefits while underweighting uncertain future outcomes. Delegates, accountable to constituents who expect tangible returns, often advocate for short-term allocations at the GM. Meanwhile, leadership struggles to justify developmental investments, especially when previous long-term programs did not yield visible outcomes or lacked follow-up support. This tendency reflects bounded rationality: under conditions of uncertainty, individuals favour simplified, immediate solutions over complex long-term plans (Simon, 1972).

This dynamic reinforces a self-perpetuating cycle: short-term allocations meet immediate needs but constrain the cooperative's ability to invest in future resilience. As long as Fairtrade Premium is interpreted primarily as a social distribution mechanism rather than a development fund, transformational investments, such as climate adaptation, organisational strengthening, or business diversification, will face resistance.

4.3 Financial Fragility as a Structural Constraint

Financial stress emerged as a central force shaping governance behaviour. Cook (2018) shows that capitalization problems, such as limited liquidity, high risk-bearing costs, and difficulties in defining residual claim rights, increase ownership costs and accelerate cooperative degeneration. When working capital is insufficient, cooperatives face rising frictions, underinvestment, and intensifying short-term pressures, which weaken strategic

focus and long-term capacity. In the Life Cycle Framework, chronic capital shortages are a major force that can push organizations toward degeneration unless they reinvent themselves. As one board member recalled, “We had to rely on our own personal funds just to keep the cooperative from collapsing.”

This financial dependency has three consequences. First, it limits the cooperative’s autonomy. Reliance on a single buyer constrains strategic decision-making, reducing the cooperative’s ability to negotiate better terms, diversify markets, or make long-term operational plans. This pattern is consistent with Chaddad and Iliopoulos (2013) observation that external transactional structures can concentrate control rights outside the cooperative, reducing its bargaining space.

Second, it heightens risk aversion. When financial reserves are thin, decision-makers prioritise projects with immediate returns or low implementation risk, typically short-term physical goods, over more uncertain long-term interventions.

Third, it pressures governance actors to treat Fairtrade Premium as a safety net rather than a development tool, inadvertently undermining Fairtrade’s developmental logic.

Thus, Premium allocation cannot be analysed independently of broader financial structures. Organisational fragility fundamentally influences what decisions are even thinkable.

4.4 Transparency, Trust, and Institutional Memory

Transparency gaps—both historical and ongoing—strongly shape trust and perceptions of legitimacy. The cooperative’s earlier crisis, when founders held disproportionate power and information was not shared openly, continues to influence how people see the organization today. As one board member recalled during restructuring, “We removed all the founders because the previous management lacked transparency.” This shows how past governance failures leave a lasting mark on organizational memory, shaping expectations and caution among current actors.

Although the cooperative has since try to adopt practices such as monthly evaluations, trust remains fragile due to inconsistent communication, limited documentation accessibility, and uneven information-sharing. This dynamic reflects Cornforth's (2004) control–support paradox, where increasing oversight can erode trust, yet too little oversight undermines accountability. Supervisory Board members recognise the importance of oversight yet struggle with unclear mandates and insufficient access to financial data. Members often receive Fairtrade Premium information indirectly or incompletely.

This situation produces a Trust–Transparency loop, where limited transparency fuels mistrust, which in turn makes leadership cautious about disclosure, perpetuating information deficits. Breaking this cycle requires not only clearer reporting systems but also deeper cultural shifts in how information is shared and interpreted within the cooperative.

4.5 Divergent Risk Perceptions and Sustainability Priorities

The study reveals fundamental differences in how cooperative actors interpret risks, particularly those related to climate change and market volatility. Board members express concern about external regulatory shifts such as EUDR, climate impacts on yield, and the structural risks of buyer dependency. In contrast, farmers often normalise climate-related shocks as routine or unavoidable. While Simon (1972) does not discuss climate risks, he explains that when environments are complex and information is limited, individuals simplify their understanding and focus on more immediate, manageable aspects of a problem. Under such bounded rationality, long-term or diffuse threats receive less attention than immediate needs. This divergence shapes Premium priorities: while leadership views long-term sustainability investments as necessary, members perceive them as secondary to short-term household needs.

Such misalignment is significant because collective action requires shared problem definitions. When actors operate with different understandings of risk, it becomes difficult to mobilise support for preventive or adaptive measures. Climate adaptation, for example, requires both behavioural change and long-term commitment. Without urgency at the member level, such programmes struggle to gain approval in the GM.

4.6 Organisational Learning and Recovery from Crisis

Despite ongoing challenges, the cooperative shows signs of constructive institutional learning. Revising the statutes to remove founder privileges marks an effort to democratize its governance structure. Monthly evaluation meetings also signal a move toward more proactive financial oversight and clearer internal communication. As one board member explained, “We hold evaluations every month so we don’t collapse again.”

These practices suggest the early stages of an organisational learning cycle, where past failures inform present strategies. However, the sustainability of these improvements depends on consistent implementation, reinforcement through training, and alignment with broader organisational norms. Without addressing deeper structural constraints, particularly capacity gaps and financial fragility, these reforms alone may not be sufficient to transform Fairtrade Premium governance.

4.7Intersections of Governance, Capacity, and Developmental Outcomes

Taken together, the findings highlight that Fairtrade’s developmental promise depends not solely on certification but heavily on internal governance capability. The cooperative’s ability to allocate Premium funds toward long-term resilience is constrained by:

- limited decision literacy among delegates
- unclear mandates across governance bodies
- financial precarity that prioritises short-term expenditures
- weak oversight due to transparency gaps
- competing risk perceptions among members and leaders
- informal power dynamics that shape deliberation

These factors create a system where even well-intentioned governance actors struggle to steer Premium decisions toward strategic development goals. The cooperative’s democratic architecture provides a foundation, but its effectiveness is undermined by structural vulnerabilities and limited organisational capacity.

5. Conclusion

This study demonstrates that the developmental potential of the Fairtrade Premium in smallholder cooperatives depends profoundly on internal governance dynamics. While democratic structures exist, their function is weakened by uneven capacity, financial fragility, informal hierarchies, and divergent risk perceptions. As a result, Premium allocations remain skewed toward short-term benefits, limiting the cooperative’s ability to invest in long-term resilience.

Strengthening decision literacy, enhancing transparency, expanding access to financial resources, and fostering shared understanding of risk are necessary conditions for transformational Premium governance. Without addressing these structural issues, the cooperative, and others like it, will continue to struggle to realise the fuller goals envisioned by Fairtrade.

Author Contributions: This study adds empirical insight into how internal governance capacity shapes Fairtrade Premium outcomes. By examining a cooperative that experienced governance failure and later restructuring, it shows that Premium allocations are driven less by certification rules and more by organisational capacity, financial vulnerability, and informal power dynamics. The study highlights how these factors reinforce short-term spending

patterns and limit long-term resilience investments, offering practical implications for strengthening decision literacy, transparency, and financial stability in Fairtrade producer organisations.

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Informed Consent Statement/Ethics approval: All subjects gave their informed consent before they participated in the study, they were informed the goal of the study, the anonymity of their participation, and how their data will be used and if there are any risks associated.

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Effect of Non-Cash Food Assistance on Work Disincentives Among Beneficiary Households in Dukuhturi, Tegal

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Abstract
Dukuhturi District in Tegal Regency consists of 18 villages, all classified as developing, with none yet reaching advanced or independent status. The Non-Cash Food Assistance Program (BPNT) is implemented to help beneficiary households meet basic food needs, strengthen economic independence, and reduce poverty sustainably. However, fulfilling part of these basic needs through BPNT may influence household decisions regarding working hours. This study analyzes the effect of BPNT on work disincentives among beneficiary households, particularly through decreases in working hours. This research uses a quantitative approach using primary data collected from questionnaires distributed to 100 BPNT beneficiary households in Dukuhturi District. The data were analyzed using Binary Logistic Regression to identify variables influencing the decrease in working hours. The results show that both the BPNT proportion and household income proportion significantly affect the decrease of household working hours. This decline appears in the working hours of both household heads and wives. For household heads, only income shows a significant effect. Meanwhile, for wives, the BPNT proportion, wife's income, and age are significant predictors. These findings indicate that wives' working hours are more responsive to social assistance than those of household heads.

Keywords: Work Disincentive, BPNT, Household, Logistic Regression

1. Introduction

Poverty in Central Java remains relatively high. In Tegal Regency alone, there are 123,520 poor residents and more than 65,000 pre-prosperous families. This condition indicates that poverty continues to be a serious issue, despite a relatively large budget allocated for poverty alleviation. Dukuhturi Subdistrict was chosen as the study site because all of its villages are categorized as developing, with an economic structure dominated by informal sectors such as trade, industry, services, and agriculture.

The Non-Cash Food Assistance Program (BPNT) is a reform of the subsidized rice program (Rastra), gradually implemented starting in 2017. Through BPNT, assistance is distributed non-cash via electronic accounts, which can only be used to purchase specific food commodities at designated e-warongs. In addition to enhancing food security, the program is designed to expand financial inclusion and improve the effectiveness of aid distribution.

However, various studies indicate that social assistance-whether cash or non-cash-has the potential to influence beneficiaries' work decisions.

Pre-survey results from 30 KPM households in Dukuhturi Subdistrict showed initial indications of reduced working hours after receiving BPNT, particularly among households with low proportions of assistance and income. Educational attainment and age also appeared to influence variations in work behavior. This situation underscores the urgency of empirically examining how BPNT affects work decisions through recipients' economic and demographic characteristics. The importance of this study is further supported by previous research showing inconsistent findings: some studies found reduced working hours (Ningtiyas, 2018; Salsabila & Purwanti, 2020; Hoynes & Schanzenbach, 2012; Prifti et al., 2019), while others reported that assistance does not necessarily reduce adult working hours and may instead affect child labor or sectoral shifts (Sulaiman, 2010; Skoufias et al., 2008). These differing results highlight a research gap regarding how food assistance—which differs in nature from cash transfers—affects poor households' labor behavior. Although several studies have explored the effect of social assistance on beneficiaries' work decisions, research specifically addressing work disincentives in food assistance programs, particularly BPNT, remains limited. Furthermore, few studies have examined how the proportion of assistance received, share of household income, education level, and age simultaneously influence the likelihood of reduced working hours among BPNT recipients.

The theoretical framework of this study is grounded in labor supply theory, which explains that non-wage income can shift individual decisions from work to leisure, as leisure is considered a normal good. This perspective aligns with Borjas (2012) and Kaufman and Hotchkiss (1999), who demonstrate that increased non-labor income can lead to reduced working hours, particularly in low-income households. In the context of welfare programs, Stiglitz (2000) and Hyman (2011) emphasize that social assistance, whether cash or non-cash, can alter budget constraints and consumption choices, thereby influencing beneficiaries' work decisions. Although BPNT is non-cash, routine receipts of significant value can still elicit responses similar to cash transfers.

Based on this theoretical foundation and empirical evidence, this study develops hypotheses regarding the influence of BPNT recipient household characteristics on reduced working hours. The proportion of BPNT assistance is expected to be positively associated with decreased working hours, consistent with Prifti et al. (2019), who found that higher proportions of assistance received increase the likelihood of reduced working hours. Conversely, the proportion of household income is predicted to be negatively associated with reduced working hours, as low-income households are more likely to reduce labor participation when receiving aid (Salsabila & Purwanti, 2020), in line with labor supply theory.

Moreover, education level and age are also considered influential factors in reducing working hours. Higher education increases employment opportunities and incentives to remain in the workforce, while individuals with lower education levels are more responsive to assistance by reducing working hours (Kaufman & Hotchkiss, 1999; Vere, 2011). Older age is expected to increase the likelihood of reduced working hours due to declining physical productivity, as Rasyid (2012) found that older household heads are more likely to reduce labor participation.

Based on this background, this study aims to analyze the effect of the Non-Cash Food Assistance Program on work disincentives among beneficiary households in Dukuhturi Sub-district, Tegal Regency.

2. Method

This study employs a quantitative approach to analyze the effect of the Non-Cash Food Assistance Program (BPNT) on the decrease in working hours among beneficiary households. The study population includes all BPNT-recipient households in Tegal Regency in 2022, totaling 112,550 beneficiary households. The sample was selected using a purposive proportional random sampling technique, which involves choosing subjects based on specific objectives or considerations relevant to the research context. The sample was drawn from six villages in Dukuhturi Sub-district: Sidakaton Village, representing areas with trade-based livelihoods; Lawatan, Karanganyar, and Pengabean Villages, representing areas with industrial or service-based livelihoods; and Dukuhturi and Sidapurna Villages, representing areas with agriculture-based livelihoods. The sample size was determined using Slovin's

formula with a population (N) of 112,550 and a 10 percent margin of error, resulting in a minimum sample size of 100 respondents. Data were collected through surveys (interviews and questionnaires) and supplemented with a literature review.

The dependent variable in this study is the decrease in working hours after receiving BPNT, measured as a binary variable. It is coded 1 for households experiencing a decrease in working hours and 0 for households not experiencing a decrease.

The decrease is measured for both the household head and the wife, resulting in the following equation:

$$DHWi = DHW_{KK} + DHW_{istri} \quad (1)$$

The independent variables include the proportion of BPNT and the income proportion for the household-level model. For the sub-models at the household head and wife levels, the dependent variables used are the proportion of BPNT, income, education, and age.

The data were analyzed using a binary logistic regression model because the dependent variables are dichotomous.

The logistic regression model for the household-level analysis is formulated as follows:

$$DHWi(Y)=\ln[\frac{Pi}{1-Pi}]= \alpha + \beta_1 BPNT_1 + \beta_2 IncomeProp_2 + \mu_i \quad (2)$$

The logistic regression model for head of household is as follows:

$$DHW_{KK} = \ln [\frac{Pi}{1-Pi}] = \alpha + \beta_1 BPNT_1 + \beta_{2P1} IncomeKK_{2P1} + \beta_{3D1} EduKK_{3D1} + \beta_{4U1} AgeKK_{4U1} + \mu_i \quad (3)$$

The logistic regression model for the wife is as follows:

$$DHW_{istri} = \ln[\frac{Pi}{1-Pi}] = \alpha + \beta_1 BPNT_1 + \beta_{2P2} IncomeIstri_{2P2} + \beta_{3D2} EduIstri_{3D2} + \beta_{4U2} AgeIstri_{4U2} + \mu_i \quad (4)$$

With:

DHWi	=	dependent variable, decreasing hours of work. This is a dummy variable, valued 1 if a decrease in working hours occurs and 0 if no decrease occurs.
Ln $[\frac{Pi}{1-Pi}]$	=	ln $[\frac{\text{Decrease in working hours occurs}}{\text{No decrease in working hours occurs}}]$
α	=	constant
$\beta_{1\ldots}\beta_4$	=	regression coefficients of each independent variable.
$BPNT_1$	=	variable indicating the proportion of the BPNT program to household food expenditure of beneficiary households (percent)
$IncomeProp_2$	=	variable indicating the proportion of total household income to household expenditure of beneficiary households (percent)
$IncomeKK_{2P1}$	=	variable indicating the total income of the household head (rupiah)
$IncomeIstri_{2P2}$	=	variable indicating the total income of the wife (rupiah)
$EduKK_{3D1}$	=	variable indicating the education level of the household head (years)
$EduIstri_{3D2}$	=	variable indicating the education level of the wife (years)
$AgeKK_{4U1}$	=	variable indicating the age of the household head (years)
$AgeIstri_{4U2}$	=	variable indicating the age of the wife (years)
μi	=	error term

Subsequently, statistical tests were conducted, as reflected in the coefficient of determination (R^2), the F-statistic, and the Z-statistic values.

3. Results and Discussion

3.1 Results

3.1.1 Respondent Household Characteristics

The sample used in this study consists of 100 households. In this study, households are categorized as pre-prosperous or poor families. The proportion of the Non-Cash Food Assistance Program (BPNT) reflects the role of BPNT in household food expenditures. The BPNT assistance is fixed for each Beneficiary Family (KPM) at IDR 200,000 per month. This assistance is intended to cover part of the household's staple food needs to improve food security and the welfare of poor families.

Based on respondent characteristics by BPNT proportion in Dukuhturi Sub-district, the distribution shows considerable variation. The majority fall within the 10.01 - 20.00 percent BPNT proportion group, while only 3 percent of households are in the 0 - 10 percent BPNT proportion group. Of the 100 BPNT-recipient households, 74 households experienced a decrease in working hours, whereas 26 households did not experience a decrease. This indicates that most households have a moderate to high dependency on BPNT assistance to meet their monthly food needs. The higher the proportion of BPNT relative to household food expenditure, the greater the tendency for a decrease in working hours. This suggests that BPNT has the potential to decrease household motivation to work.

Table 1: Household Characteristics Based on BPNT Proportion and Household Income Proportion

Characteristic	Group	Decrease in Working Hours (Household)	Percentage of Working Hours Decreased (%)	No Decrease in Working Hours (Household)	Percentage of No Decrease in Working Hours (%)	Total
BPNT Proportion (%)	0 - 10.00	0	0.00	3	100.00	3
	10.01 - 20.00	34	65.38	18	34.62	52
	20.01 - 30.00	33	86.84	5	13.16	38
	30.01 - 40.00	5	100.00	0	0.00	5
	40.01 - 45.00	2	100.00	0	0.00	2
Total		74		26		100
Household Income Proportion (%)	0 - 40.00	1	100.00	0	0.00	1
	40.01 - 80.00	42	80.77	10	19.23	52
	80.01 - 120.00	31	67.39	15	32.61	46
	120.01 - 160.00	0	0.00	1	100.00	1
Total		74		26		100

Source: Primary Data, 2025, processed.

The household income proportion reflects the percentage of a household's total income relative to its total expenditures. This proportion indicates the household's capacity to meet monthly needs. Income refers to all earnings obtained by the household, whether from work or non-work sources. The households in question are Beneficiary Families (KPM) that receive BPNT. Data in Table 1 show that households with a medium income proportion (40.01 - 80.00 percent) have a higher tendency to experience a decrease in working hours, at 80.77 percent. Conversely, households with a high-income proportion (120.01 - 160.00 percent) tend not to experience a decrease in working hours.

In this study, the analysis of the decrease in working hours was conducted by examining changes in the working hours of household heads and wives. This approach was applied to identify whether the decrease in working hours occurred for both or was concentrated on one of them.

Based on Table 2, the decrease in working hours among household heads is more dominant in groups with a higher BPNT proportion. In the low BPNT proportion group (0 - 20 percent), most household heads maintained their working hours. The decrease then rose from 36.84 percent in the 20.01 - 30 percent group to 80 percent in the 30.01 - 40 percent group and 100 percent in the 40.01 - 45 percent group. Among wives, the decrease in working hours was more pronounced compared to household heads. It increased from 51.92 percent in the 10.01 - 20

percent group to 73.68 percent in the 20.01 - 30 percent group, reaching 100 percent in the higher BPNT proportion group (30.01 - 45 percent). Overall, the decrease in working hours in BPNT-recipient households mostly occurs among wives. This indicates that with the provision of assistance, wives tend to reduce work intensity and focus more on domestic activities or household management, while husbands' productive roles remain relatively stable.

Table 2: Household Characteristics Based on BPNT Proportion (Head of Household and Wife)

BPNT Proportion (%)	Head of Household		Wife	
	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)
0 - 10.00	0.00	100.00	0.00	100.00
10.01 - 20.00	11.54	88.46	51.92	48.08
20.01 - 30.00	36.84	63.16	73.68	26.32
30.01 - 40.00	80.00	20.00	100.00	0.00
40.01 - 45.00	100.00	0.00	100.00	0.00

Source: Primary Data, 2025, processed.

The analysis of respondent characteristics by income level is presented in Table 3, which classifies respondents into specific income intervals. This grouping aims to provide a more structured overview of income distribution between household heads and wives, as well as its relation to the tendency of changes in working hours in beneficiary households.

Table 3: Household Characteristics Based on Income (Head of Household and Wife)

Income (Rupiah/Month)	Head of Household		Wife	
	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)
0 - 500,000	84.61	15.39	72.00	28.00
500,001 - 1,000,000	28.85	71.15	36.36	63.64
1,000,001 - 1,500,000	0.00	100.00	0.00	100.00
1,500,001 - 2,000,000	0.00	100.00	0.0	100.00
2,000,001 - 2,500,000	0.00	100.00	-	-
2,500,001 - 3,000,000	0.00	100.00	-	-

Source: Primary Data, 2025, processed.

Income-based analysis shows that the decrease in working hours occurs more frequently in lower-income households. For household heads, the decrease is dominated by the IDR 0 - 500,000 income group (84.61 percent), decreasing to 28.85 percent in the IDR 500,001 - 1,000,000 group, and not occurring in households earning above IDR 1,000,000. A similar pattern is observed among wives, with the highest decrease in the 0 - 500,000 income group (72 percent), decreasing to 36.36 percent in the 500,001 - 1,000,000 group, and no decrease above 1,000,000. Overall, the decrease in working hours is more dominant in low-income households, whereas middle- to high-income households tend to maintain their working hours.

Education reflects an individual's ability to make decisions and take appropriate actions. It also plays a key role in shaping thought processes and behavioral patterns. Based on Table 4, the education level of household heads and wives in BPNT-recipient households in Dukuhturi Sub-district is generally low. Most respondents have only completed primary education (≤6 years), with a small proportion reaching lower or upper secondary education.

Table 4: Household Characteristics Based on Education (Head of Household and Wife)

Length of School (Years)	Head of Household		Wife	
	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)	Percentage of Working Hours Decreased (%)	Percentage of No Decrease in Working Hours (%)
≤ 6	33.33	66.67	63.53	36.47
7 - 9	9.09	90.91	57.14	42.86
9 - 12	0.00	100.00	0.00	100.00

Source: Primary Data, 2025, processed.

The decrease in working hours mainly occurs among household heads with low education levels. Household heads with ≤6 years of schooling experienced a 33.33 percent decrease, while those with 7 - 9 years of schooling had a 9.09 percent decrease, and no decrease was observed in the 9 - 12 years education group. This indicates that the higher the household head's education, the less likely a decrease in working hours occurs. Among wives, the decrease is also more pronounced at lower education levels, with a higher proportion compared to household heads. Wives with ≤6 years of schooling experienced a 63.53 percent decrease, and those with 7 - 9 years of schooling experienced a 57.14 percent decrease, while no decrease was observed in the 9 - 12 years group. These findings indicate that wives' education also influences labor participation patterns within the household.

Age is an important demographic factor closely related to physical capacity in determining whether to work or not. In general, the productive age group tends to have higher work capacity and greater economic participation compared to the non-productive age group.

Table 5: Household Characteristics Based on Age (Head of Household and Wife)

Category	Age Group	Percentage of Decrease in Working Hours (%)	Percentage of No Decrease in Working Hours (%)
Head of Household	27 - 36	6.67	93.33
	37 - 46	17.07	82.93
	47 - 56	19.23	80.77
	57 - 66	58.33	41.67
	67 - 75	100.00	0.00
Wife	25 - 34	78.57	21.43
	35 - 44	59.57	40.43
	45 - 54	56.00	44.00
	55 - 64	63.64	36.36
	65 - 73	66.67	33.33

Source: Primary data, 2025, processed

Based on Table 5, the pattern of decrease in working hours differs between household heads and wives. Household heads in the productive age range (37 - 56 years) mostly maintained their working hours (82.93 percent for ages 37 - 46 and 80.77 percent for ages 47 - 56). The decrease increases in older age groups, reaching 58.33 percent for ages 57 - 66 and 100 percent for ages 67 - 75, influenced by declining physical capacity and productivity. Meanwhile, among wives, the decrease in working hours occurs more in the productive age range, especially ages 25 - 44. Wives aged 25 - 34 experienced a 78.57 percent decrease, while those aged 35 - 44 experienced a 59.57 percent decrease, mainly due to childcare responsibilities. In older age groups (45 - 73 years), the decrease remains high, ranging between 56 - 66.67 percent.

Overall, it can be concluded that respondents in this study, both household heads (husbands) and wives, generally fall within the productive age range. However, there are differences in the tendency of decrease in working hours

between them. Among household heads, the decrease occurs more in older age groups (over 57 years). In contrast, among wives, the decrease is more dominant in the productive age group, particularly ages 25 - 44.

3.1.2 Results of Logistic Regression

Household working hour decreases include both head of household and wife. Household-level analysis uses BPNT proportion and household income proportion as observable variables. Individual-level analysis includes BPNT proportion, income of husband and wife, education, and age.

Table 6: Estimation Results Using the Binary Logit Regression Model (Households)

Variable	Coefficient	Z-Stat	Prob.	*Odds* Ratio
BPNT Proportion ($BPNT_1$)	0,310625	3,651200	0,0003	1,364233
Income Proportion ($IncomeProp_2$)	-0,116960	-3.765655	0,0002	0,889662
Constant	5,130606	2,220928	0,0264	169,464364
LR Stastistic	45,38377		0,000000	
McFadden R-squared	0,395980			

Source: Eviews Output Results (processed)

Table 7: Estimation Results Using the Binary Logit Regression Model (Head of Household)

Variable	Coefficient	Z-Stat	Prob.	*Odds* Ratio
BPNT Proportion ($BPNT_1$)	-0,013738	-0,184023	0,8540	0,986358
Income ($IncomeKK_2$)	-5,12E-06	-2,657438	0,0079	0,999995
Education ($EduKK_{3D1}$)	-0,095378	-0,723483	0,4694	0,909025
Age ($AgeKK_{4U1}$)	0,053681	1,412892	0,1577	1,055170
Constant	1,370508	0,430867	0,6666	3,937556
LR Stastistic	43,58690		0,000000	
McFadden R-squared	0,380302			

Source: Eviews Output Results (processed)

Table 8: Estimation Results Using the Binary Logit Regression Model (Wife)

Variable	Coefficient	Z-Stat	Prob.	*Odds* Ratio
BPNT Proportion ($BPNT_1$)	0,219618	3,473918	0,0005	1,245518
Income ($IncomeIstri_2$)	-4,04E-06	-2,314097	0,0207	0,999996
Education ($EduIstri_{3D2}$)	-0,002238	-0,018847	0,9850	0,997765
Age ($AgeIstri_{4U2}$)	-0,110613	-2,683744	0,0073	0,895354
Constant	2,856051	1,486385	0,1372	17,400583
LR Stastistic	33,77285		0,000001	
McFadden R-squared	0,254289			

Source: Eviews Output Results (processed)

Based on the logistic regression results for households, heads of households, and wives, the results are as follows:

1. $DHWi(Y) = 5.130606 + 0.310625\ (BPNT_1)^* - 0.116960\ (IncomeProp_2)^*$
2. $DHW_{KK} = 1.370508 - 0.013738\ (BPNT_1)^* - 5.12E\text{-}06\ (IncomeKK_2)^* - 0.095378\ (EduKK_{3D1})^* + 0.053681\ (AgeKK_{4U1})^*$
3. $DHW_{Istri} = 2.856051 + 0.219618\ (BPNT_1)^* - 4.04E\text{-}06\ (IncomeIstri_2)^* - 0.002238\ (EduIstri_{3D2})^* - 0.110613\ (AgeIstri_{4U2})^*$

*Note: *: significant at the 5 percent level of the Z-test*

Table 6: Summary of Results of the Effect of BPNT on the Decrease in Working Hours by Household, Head of Family, and Wife

Independent Variable	Household	Head of Household	Wife
BPNT Proportion *($BPNT_1$)*	Significant	Not Significant	Significant
Household Income Proportion *($IncomeProp_2$)*	Significant	-	-
Head of Household Income *($IncomeKK_{2P1}$)*	-	Not Significant	-
Wife Income *($IncomeIstri_{2P2}$)*	-	-	Significant
Head of Household Education *($EduKK_{3D1}$)*	-	Not Significant	-
Wife Education *($EduIstri3_{D2}$)*	-	-	Not Significant
Head of Household Age *($AgeKK_{4U1}$)*	-	Not Significant	-
Wife Age *($AgeIstri_{4U2}$)*	-	-	Significant

Source: Eviews Output Results (processed)

3. 2 Discussion

3.2.1 BPNT Proportion

The BPNT proportion variable at the household level shows a positive and significant effect on the decrease in household working hours. This means that the higher the proportion of BPNT received, the greater the likelihood that households experience a decrease in working hours. This finding is consistent with Prifti et al. (2019), who found that the higher the proportion of assistance, the greater the percentage of households that decrease their working hours.

Furthermore, since the decrease in household working hours consists of the decrease in the working hours of the household head and the wife, an analysis of the household head shows that the BPNT proportion variable is not significant for the decrease in the household head's working hours. In contrast, this variable has a positive and significant effect on the decrease in the wife's working hours. These findings indicate that BPNT does not significantly influence the household head's decision to reduce working hours. As the primary earner, the household head tends to maintain work intensity due to economic orientation and family financial responsibilities. Additionally, the BPNT amount received is relatively small and insufficient to replace part of the income from labor. Thus, even with social assistance, the household head continues to work at the same intensity to maintain family economic stability.

Overall, at the household level, the decrease in working hours primarily occurs among wives. This finding aligns with Alzua, Cruces, & Ripani (2013), who analyzed the PROGRESA program in Mexico and found that social assistance led to a significant decrease in female labor participation. Teixeira (2010) also reported similar findings, indicating that the decrease in working hours is more dominant among female beneficiaries.

3.2.2 Household Income Proportion, Head of Household Income, and Wife's Income

The household income proportion variable shows a negative and significant effect on the decrease in working hours. Household head income and wife's income also exhibit a negative and significant effect. This indicates that both household heads and wives with lower income have a higher likelihood of decreasing working hours compared to households with higher income.

In this context, although the opportunity changes are relatively small, beneficiary households tend to adjust their working hours when household economic burdens are slightly eased through social assistance. However, since the BPNT amount is not substantial, the reduction in working hours is not extreme but rather represents flexible

adjustments. These results are consistent with Salsabila and Purwanti (2020), who found that individuals earning lower wages reduce labor participation when receiving government assistance.

3.2.3 Education

The household head's education variable does not significantly affect the decrease in working hours. Most household heads in Dukuhturi Sub-district work in the informal sector, such as farm laborers, construction workers, or daily wage jobs, where income depends on the number of working days or output. In this context, education is not a primary factor in decisions regarding working hours. This finding aligns with Rasyid (2012), who stated that education level does not significantly affect the labor supply decisions of assistance recipients.

On the other hand, the wife's education shows a negative and significant effect on the decrease in working hours. This supports Vere (2011), who found that individuals with lower education levels are more responsive to government social protection programs. In other words, the lower a person's education level, the higher the likelihood that they adjust their economic behavior in response to received assistance.

3.2.4 Age

The household head's age variable does not significantly affect the decrease in working hours. Most household heads in Dukuhturi Sub-district are in the productive age range (30–55 years) with high economic responsibilities, so they maintain their working hours even when receiving social assistance. In contrast, the wife's age shows a negative and significant effect. This means that as the wife's age increases, the likelihood of reducing working hours decreases. This finding differs from Rasyid (2012), who stated that older individuals are more likely to reduce working hours.

The decrease in working hours among younger wives can be explained by the age characteristics of BPNT recipients in Dukuhturi Sub-district. Field observations indicate that most recipients in this area are young women with young children, which leads them to reduce their working hours. Meanwhile, older women generally have adult children and lighter caregiving responsibilities, so they maintain their usual working hours without being significantly influenced by the assistance received.

4. Conclusion

Based on the findings from households receiving the Non-Cash Food Assistance Program (BPNT) in Dukuhturi Sub-district, several conclusions can be drawn regarding the influence of socio-economic characteristics on the decrease in working hours at the household, household head, and wife levels. At the overall household level, the BPNT proportion has a positive and significant effect on the decrease in household working hours, whereas the household income proportion has a negative and significant effect on the decrease in working hours.

For household heads, income has a negative and significant effect on the decrease in the household head's working hours. Meanwhile, the variables of BPNT proportion, education, and age of the household head do not show significant effects. This is due to the household head's obligation to continue working, as the BPNT amount received is relatively small and insufficient to meet the household's total needs without employment. Additionally, the generally low economic conditions of beneficiary households lead household heads to maintain their work activities regardless of education level or age.

For wives, the BPNT proportion has a positive and significant effect on the decrease in working hours, while income and age have negative and significant effects. Wife's education, however, does not have a significant effect because most wives have relatively low education levels, which limits their influence on work decisions.

Overall, the BPNT program has been shown to decrease household working hours. This reduction primarily occurs in households where the BPNT assistance proportion is relatively large compared to total household expenditures. The assistance encourages wives to reduce working hours and allocate more time to other non-work activities.

Meanwhile, for household heads, BPNT does not have a significant effect on working hours, as they continue to feel responsible for meeting the household's overall needs.

For future research, it is recommended to broaden the household characteristics studied. This should not only focus on households consisting of a household head (husband) and wife, but also include other household types such as single-person households, households without a wife, or households with other family members involved in productive activities. In addition, future studies should consider adding other independent variables, such as the number of dependents, as these factors may influence household work decisions.

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How Succession Planning Quality and Successor Leadership Style Shape Performance in Family Healthcare Businesses

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Abstract
The succession of leadership is a most important strategic issue facing family healthcare businesses especially when founder-doctors are retiring to professional managers. The present research is aimed at investigating the impact of the quality of succession planning and successor leadership style on the organizational performance, the employee performance is a possible mediating variable, in Indonesian family clinics experiencing the first to the second generation of leadership transitions. A quantitative approach was adopted based on the Social Exchange Theory, the Resource-Based View and Transformational Leadership Theory and utilized survey data collected by the respondents in various family clinics organizations. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze the data. The results indicate that the quality of succession planning plays a significant role in determining the employee performance and the performance of the organization. On the same note, successor leadership style has a lot of positive impacts on employee performance and organizational performance. Employee performance however does not have significant influence on organizational performance and as such does not mediate the relationships between independent variables and organizational performance. The research model has indicated a significant explanatory ability regarding employee performance as well as organizational performance. The results imply that in the context of family clinic succession, the quality of succession planning and the successor leadership style are direct causes of the organizational performance and do not mediate their effects via the employees. The research makes a contribution to succession and leadership literature by providing empirical findings in a developing market healthcare setting and making practical implications to family clinic proprietors on the effective management of leadership transitions.

Keywords: Succession Planning, Leadership Style, Organizational Performance, Employee Performance, Family Business, Healthcare

1. Introduction

Succession in leadership is one of the most important strategic concerns in the sustainability of an organization, especially in the case of family business. The issue of leadership succession becomes even more complicated in the context of the healthcare services industry because organizations are not only to ensure the stable operation of the organization, but also to sustain the quality of healthcare services that have a direct influence on the welfare of the population. The nature of family business in the healthcare sector presents family clinics with special

challenges in the leadership transition process particularly where it involves the transition of the founding generation (founder-doctor) to successors with professional managerial orientation. Such a transition is not only a transfer of formal power, it is also a transfer of organizational values, long-term vision, and work culture, gained over many years.

The process of leadership succession makes a core of leadership development and a critical business approach since it boosts the success of the organization in ensuring seamless transitions and sustaining the productivity levels (Kim, 2012). Companies that have well-established succession planning are usually consistent in both financial and operational performance even at times of transition which are usually prone to instability. Regarding a long-term outlook, family businesses that effectively achieve a change in leadership are more probable to be survived to the third and even to the fourth generation and this, according to literature, is only attained by a very small percentage of family businesses in the world.

The role of succession planning is also more important to effective succession planning when considered in the case of healthcare organizations, as the healthcare industry still falls behind other corporate organizations in terms of succession planning and succession retention (Blouin et al., 2006). This has led to high shortage of effective succession planning strategies and tactics, not only at the executive level, but also in the middle level. The systematic review conducted by Hermes et al. (2025) revealed that the turnover of CEO in a hospital is a particularly common and serious organizational event, the predictors of CEO turnover and its outcomes are not well comprehended. According to their research results, the turnover of CEO may lead to a short-term loss of finance and a high probability of organisational failure especially when the turnover is unexpected or unplanned.

The lack of leadership style compatibility between the first and the second generations is one of the main problems of succession within family clinics where the first generation, which is usually comprised of doctors or founders, is unsuitable to the professional managers who have a professional orientation towards their leadership. The founding generation that has a clinical background is more likely to use leadership styles that are grounded in medical experience, practical experience as well as close personal relationship with the patient and employees. Conversely, the next generation of successors who have undergone formal education in management is more likely to use more formalized, systemic and data-driven practices. According to Ganesan et al. (2025), the development of leadership is a key element of increasing the sustainability of healthcare organizations in the long term and their efficiency. Despite the Leadership Pipeline Model being an effective tool in increasing workforce engagement, succession planning, and the overall quality of healthcare services, it has certain barriers to implementation, including the lack of training support, lack of compatibility with clinical expertise, and resistance to change.

This is an area that cannot be neglected in the study of leadership transition due to the role of the succession process in the stability of the organization and performance of the employees. As the most prized asset in the healthcare service organizations, employees can be extremely sensitive to leadership changes and react to these changes in different ways influencing their performance. Within the family clinic setting, uncertainty among employees due to the poor planning of the succession process may lead to a decline in the motivation to work, commitment to the organization, and, consequently, the performance of the employees (Thomas et al., 2025). Hermes et al. (2025) postulate that early and orderly succession planning is essential in hospitals where CEOs have a high probability of leaving office to raise the level of leadership stability, lower recruitment expenses, and organizational resilience.

Past studies reveal that the succession of leadership has complicated and diversified effects on healthcare institutions, but a gap exists in the specific effects of succession process on employee performance and organizational performance of family clinics in Indonesia. Much of the available literature is on the large hospitals or healthcare organizations in developed nations, and little has been done on the specifics of family clinics as family businesses in the Indonesian cultural environment. On this gap, the current study will examine how succession planning quality and successor leadership style affect the performance of organizations by using employee performance as an intermediary variable in family clinics in Indonesia where the first generation to the second generation leadership transition occurs.

2. Literature Review

2.1 Theoretical Foundation

The three theoretical perspectives in this study can explain the relationship between succession planning quality, successor leadership style, performance of employees, and performance of an organization. According to Social Exchange Theory (Blau, 1964), social interactions are founded on the principles of reciprocity where people build relationships under the hope of receiving back with time. With systematic succession planning and effective leadership by the organizations, the employees will have a sense that the organization is committed to stability and growth and develop an obligation to respond with increased performance. The high-quality succession planning and leadership capabilities are placed in the Resource-Based View Theory (Barney, 1991) as the sources of the sustainable competitive advantage. Companies that own such beneficial, scarce and hard to imitate resources are able to continue achieving high performance even when the leadership is changed. The Transformational Leadership Theory (Bass, 1985) describes how leaders with idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration are able to boost the motivation and performance of the followers beyond normal expectations, which is of crucial importance in the case of succession transitions when employees experience uncertainty and organizational change.

2.2 Succession Planning Quality

Succession planning is an organised exercise towards providing continuity in leadership in strategic roles, retaining and nurturing intellectual capital and promoting individual growth (Rothwell, 2010). Successful succession planning is high-quality, which is defined by organized planning systems, successor preparation and training, knowledge transfer systems, and communication with the stakeholders (Kim, 2012). Succession planning acquires new significance in the healthcare context, where healthcare services are of vital importance, and the leadership requirements are challenging. Studies have established that in the past healthcare organizations have been and continue to be left behind in terms of systemic succession planning and this leads to leadership turnover and organizational changes that are unstable (Blouin et al., 2006). Hermes et al. (2025) discovered that systematic succession planning plays an important role in enhancing stability in leadership, cutting back on the expenses upheld in theory of recruiting new personnel, and securing the financial stability of the medical organization.

2.3 Successor Leadership Style

Leadership style is the peculiar patterns of behaviors and influence strategies that leaders use in the process of managing organizational actions in order to achieve goals. Transformational leadership whose idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration have been identified to be of relevance especially in healthcare settings has become especially relevant in the view of the knowledge based nature of healthcare organizations and the professional nature of the workforce in healthcare organizations (Bass and Riggio, 2006). The issue of successor leadership style is critical in the context of succession as the new leader should develop credibility, build trust, and inspire employees in the transition of uncertainty. The medical literature has always demonstrated that transformational leadership positively influences employee satisfaction, burnout, patient outcomes, and the performance of the organization (Ganesan et al., 2025; Thomas et al., 2025).

2.4 Employee Performance

Organizational performance describes how well an organization can accomplish strategic goals, effectively manage its resources and generate sustainable value in the financial, operation, service quality and strategic dimensions (Kaplan and Norton, 1992). Organizational performance is especially relevant in a succession setting because leadership transitions may increase or decrease organizational performance. Studies have always shown that the succession activities cause the volatility in performance, and the magnitude and the period of disruption are highly dependent on the quality of succession planning and the effectiveness of successors to lead the organization (Kim, 2012; Haveman et al., 2001).

2.5 Employee Performance

There are the task performance, adaptive performance, employee engagement as well as retention of employees (Borman and Motowidlo, 1993; Pulakos et al., 2000). In the context of succession, performance is not only based upon individual performance, but also based on the reaction that employees show towards a new leadership and how well they adapt to the dynamism of the organisation. It has been shown that properly run succession practices sustain or improve the performance of the employees by removing uncertainty and giving them a sense of direction within the organization and poorly operated successions will lead to employee performance deterioration through anxiety, confusion and lack of motivation (Thomas et al., 2025).

2.6 Hypothesis Development

Based on the theoretical framework and literature analysed, this paper suggests a combined conceptual framework of analysing the relationship between the succession planning quality and successor leadership style, employee performance and organizational performance. The framework assumes that a quality of succession planning and a style of successor leadership can affect organizational performance in two ways, both as a direct strategic resource, and indirectly as a result of its influence on employee performance. The proposed conceptual framework is shown in Figure 1.

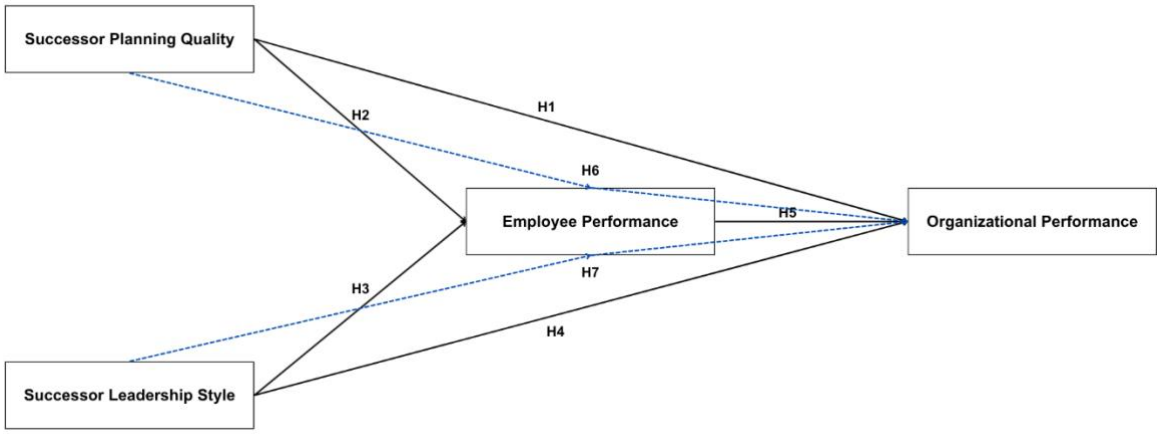

Figure 1: Conceptual Framework

According to the Resource-Based View Theory, the high-quality succession planning serves as a strategic capability that directly leads to organizational performance by guaranteeing leadership continuity and organizational knowledge retention. This correlation is supported by the existing literature because mature organizations in terms of succession planning record positive financial and operational results (Kim, 2012; Hermes et al., 2025). Thus:
H1: Succession planning quality has a positive effect on organizational performance.

According to Social Exchange Theory, when an organization invests in succession planning, employees develop a sense of stability and support that initiates the development of reciprocity in the form of increased performance. Studies have indicated that successful succession planning helps to minimize uncertainty in employees and increase engagement in the process (Desarno et al., 2020). Thus:
H2: Succession planning quality has a positive effect on employee performance.

Transformational Leadership Theory assumes that transformational leaders with transformational practices attain high organizational performance through motivation and organizational culture. Healthcare studies prove that transformational leadership has positive correlations with organizational performance (Alshammari et al., 2024; Ganesan et al., 2025). Thus:
H3: Successor leadership style has a positive effect on organizational performance.

Transformational leadership promotes the performance of employees by motivating, supporting them individually and by offering intellectual stimulation. The obtained extensive research shows that transformational leadership has strong positive correlations with employee performance in healthcare environments (Alshaabani et al., 2021; Durowade et al., 2020). Thus:
H4: Successor leadership style has a positive effect on employee performance.

Employee performance is a very important mechanism which connects organizational practices and organizational outcomes. Organizations record high financial, operation, and service quality outcomes when employees are doing well (Thomas et al., 2025). Thus:
H5: Employee performance has a positive effect on organizational performance.

According to the Social Exchange Theory, the relationship between succession planning quality and successor leadership style and organizational performance may come through the performance of employees as a mediating variable. The organizational investments on planning and leadership have an effect on the employees in attitudes and behaviour which in turn results to organizational outcomes. Thus:
H6: Employee performance mediates the relationship between succession planning quality and organizational performance.
H7: Employee performance mediates the relationship between successor leadership style and organizational performance.

3. Methods

The given research has a quantitative approach and explanatory research design to discuss the causal relationships between the quality of succession planning, successor leadership style, employee performance, and organizational performance. A cross-sectional survey was done to gather information about family clinics that experienced a first-to-second generation leadership change in Indonesia. The design allows testing numerically a set of hypotheses derived theoretically using statistical methods.

The sample population consists of family-owned healthcare clinics in Indonesia in the transition of first-to-second generation leadership. To meet the criteria the eligible clinics have to address the following items: (1) the leadership has to shift to the second-generation leadership, (2) the clinic must have a minimum of 10 staff members, (3) the successor leaders and employees must be willing to be included in the research. A combination of purposive and snowball sampling was used as non-probability sampling, which created the final sample of 200 respondents from various family clinic organizations.

Structured questionnaires were used to collect primary data to minimize the occurrence of common method bias by adopting a multi-source strategy that required the use of successor leaders who rated the quality of succession planning and organizational performance as well as the employees who rated the successor leadership style and rated their performance. All measures were performed with the help of the established scales that applied a 5-point Likert scale starting with 1 (strongly disagree), up to 5 (strongly agree). Table 1 shows the definition and source of measurement of each variable.

Table 1: Operationalization of Variables

Variable	Operational Definition	Dimensions	Items	Source
Succession Planning Quality	The extent to which the organization has implemented systematic, comprehensive, and effective processes for identifying, developing, and transitioning leadership from founder to successor	Systematic planning, successor readiness, knowledge transfer, stakeholder communication	8	Kim (2012); Rothwell (2010)

Variable	Operational Definition	Dimensions	Items	Source
Successor Leadership Style	The characteristic patterns of transformational leadership behaviors demonstrated by the successor leader in guiding and influencing employees during the succession transition	Idealized influence, inspirational motivation, intellectual stimulation, individualized consideration	12	Bass & Avolio (1995)
Employee Performance	The degree to which employees effectively fulfill job responsibilities, adapt to organizational changes, demonstrate work engagement, and maintain commitment to the organization during succession transition	Task performance, adaptive performance, employee engagement, retention	8	Williams & Anderson (1991); Pulakos et al. (2000); Schaufeli et al. (2006)
Organizational Performance	The extent to which the family clinic achieves desired outcomes across financial, operational, service quality, and strategic dimensions during and after succession transition	Financial performance, operational performance, service quality performance, strategic performance	8	Kim (2012); Kaplan & Norton (1992)

The analysis of the data was done with the help of Partial Least Squares Structural Equation Modeling (PLS-SEM) and SmartPLS 4.0. The measurement model was considered using factor loading and Average Variance Extracted (AVE) to evaluate convergent validity, Heterotrait-Monotrait (HTMT) ratio and Fornell-Larcker criterion to evaluate discriminant validity, and Cronbachs Alpha and Composite Reliability to evaluate reliability. The structural model was evaluated by examining the coefficient of determination (R^2), path coefficients significance through bootstrapping with 5,000 subsamples, and mediation effects, where hypotheses were supported when path coefficients demonstrated statistical significance at $p < 0.05$.

4. Results

4.1 Respondent Demographics

Two hundred valid responses were gathered among the workers in various family clinic organizations that were experiencing the first to second generation leadership succession in Indonesia. Table 2 will show the demographics of the respondents and the organizational profiles.

Table 2: Respondent Demographics

Characteristic	Category	Frequency	Percentage
Age	18-30 years	55	27.5%
	31-40 years	68	34.0%
	41-50 years	67	33.5%
	>50 years	10	5.0%
Gender	Male	101	50.5%
	Female	99	49.5%
Education	High School/Diploma	57	28.5%
	Bachelor	84	42.0%
	Professional/Master/Doctoral	59	29.5%
Position	Doctor	42	21.0%
	Administration	60	30.0%
	Pharmacy	35	17.5%

Characteristic	Category	Frequency	Percentage
	Laboratory	30	15.0%
	Others	33	16.5%
Work Tenure	<5 years	76	38.0%
	6-9 years	85	42.5%
	≥10 years	39	19.5%
Clinic Revenue (Monthly)	<250 million IDR	30	15.0%
	250-499 million IDR	120	60.0%
	≥500 million IDR	50	25.0%

The demographic picture shows that there were equal genders with the males constituting 50.5% and the females 49.5 percent. Most of the respondents are at their productive age of 31-50 years (67.5%), which indicates mid-career professionals with considerable organization experience that is pertinent in evaluating the dynamics of succession. Regarding the level of education the biggest percentage of 42.0% has Bachelor, then Professional/Master/Doctoral (29.5%) and High School/Diploma (28.5%) meaning that there is a well-educated workforce that can make informed reviews on the quality of leadership and the organization practices.

The position breakdown is varied with the largest proportion of administration staff (30.0%), doctors (21.0%), pharmacy (17.5%), lab (15.0%) and other support functions (16.5%). About the work tenure, most of the respondents have worked over five years (62.0%), with the highest percentage of 6-9 years (42.5%). Such long organizational experience is especially important since these employees have enough experience to observe and evaluate the succession processes and differentiate between leadership styles of founders and successors. When it comes to organizational profile, most of the clinics make monthly revenue of 250-499 million IDR (60.0%), which shows the average-sized family healthcare businesses that are characteristic of the healthcare environment in Indonesia.

4.2 Measurement Model Evaluation

Evaluation of measurement model was done to measure convergent validity, discriminant validity, and reliability to make certain that measurement instruments sufficiently measure intended constructs before testing structural relationships. This is an important assessment given that the results of structural model can only be significant when they are founded on sound and valid measurement (Hair et al., 2017). Convergent validity focuses on whether indicators of the same construct have common substantial proportion of variance, discriminant on the other hand evaluates whether or not constructs are empirically dissimilar, and reliability evaluates whether indicators of the same construct yield consistent results.

Factor loading and Average Variance Extracted (AVE) were used to determine convergent validity, which the factor loadings must be greater than 0.70 and the AVE value must be not less than 0.50 (Hair et al., 2017). The indicators, as shown in Table 3, show a factor loading of above the minimum, as shown in the values of 0.794 to 0.877. The quality of Succession Planning has the highest factor loadings on average with the highest loading of SPQ5 being 0.877. All four constructs have an AVE that is above 0.50 with Succession Planning Quality showing the best AVE (0.697) as compared to other constructs such as Employee Performance (0.680), Organizational Performance (0.668), and Successor Leadership Style (0.652). These findings establish a reasonable level of convergent validity of all constructs.

Table 3: Convergent Validity Results

Variable	Indicator	Factor Loading	AVE
Succession Planning Quality (SPQ)	SPQ1	0.854	0.697
	SPQ2	0.832	
	SPQ3	0.815	
	SPQ4	0.844	
	SPQ5	0.877	

Variable	Indicator	Factor Loading	AVE
	SPQ6	0.807	
	SPQ7	0.832	
	SPQ8	0.816	
Successor Leadership Style (SLS)	SLS1	0.806	0.652
	SLS2	0.800	
	SLS3	0.801	
	SLS4	0.802	
	SLS5	0.847	
	SLS6	0.809	
	SLS7	0.796	
	SLS8	0.810	
	SLS9	0.803	
	SLS10	0.800	
	SLS11	0.820	
	SLS12	0.794	
Employee Performance (EP)	EP1	0.843	0.680
	EP2	0.824	
	EP3	0.804	
	EP4	0.827	
	EP5	0.841	
	EP6	0.828	
	EP7	0.833	
	EP8	0.798	
Organizational Performance (OP)	OP1	0.799	0.668
	OP2	0.809	
	OP3	0.851	
	OP4	0.792	
	OP5	0.821	
	OP6	0.824	
	OP7	0.796	
	OP8	0.844	

Heterotrait-Monotrait (HTMT) ratio and Fornell-Larcker were used to assess discriminant validity. The ratio of HTMT compares between-trait correlations to within-trait correlations and values lower than 0.85 represent sufficient discriminant validity (Henseler et al., 2015). Table 4 illustrates that all the HTMT ratios are below the conservative value of 0.85 with a range of 0.730 to 0.837, which confirms that all construct pairings show adequate differentiation among themselves.

Table 4: Heterotrait-Monotrait (HTMT) Ratio

	EP	OP	SLS	SPQ
Employee Performance (EP)				
Organizational Performance (OP)	0.730			
Successor Leadership Style (SLS)	0.757	0.817		
Succession Planning Quality (SPQ)	0.786	0.837	0.763	

Fornell-Larcker criterion is that the square root of AVE of each construct should be greater than the correlation it has with all the other constructs (Fornell and Larcker, 1981). As seen in Table 5, all the constructs show square roots of AVE, which are higher than their correlations to the other constructs. The square root of AVE of the Employee Performance is 0.825, which is higher than with the Organizational Performance (0.683), Successor

Leadership Style (0.718), and Succession Planning Quality (0.742). These findings provide sufficient discriminant validity of the measurement model.

Table 5: Fornell-Larcker Criterion

	EP	OP	SLS	SPQ
Employee Performance (EP)	**0.825**			
Organizational Performance (OP)	0.683	**0.817**		
Successor Leadership Style (SLS)	0.718	0.771	**0.807**	
Succession Planning Quality (SPQ)	0.742	0.784	0.724	**0.835**

Note: Diagonal values in bold represent the square root of AVE for each construct

The reliability was tested using Cronbach Alpha and Composite Reliability with a score of 0.70 and above accepted as acceptable reliability (Hair et al., 2017). Table 6 demonstrates a high internal consistency of all constructs with the values of all constructs being larger than the 0.90 mark. The highest reliability is shown by Successor Leadership Style with the Cronbachs Alpha 0.951 and Composites Reliability rho c 0.957 which is remarkable by the fact that the number of indicators included in this construct is the largest (12 items). Consistency of all the measures of reliability shows that the measurement is stable and robust which corroborates the quality of the measurement model to further strict structural model analysis.

Table 6: Reliability Results

Variable	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)
Succession Planning Quality	0.938	0.940	0.948
Successor Leadership Style	0.951	0.952	0.957
Employee Performance	0.933	0.934	0.945
Organizational Performance	0.929	0.930	0.941

4.3 Structural Model Evaluation

Structural model was tested after ensuring that there was sufficient quality of measurement model in the study to test the hypothesis looking at the relationship between constructs. In this analysis, the coefficient of determination (R^2) to determine the explanatory power of a model and path coefficients significance to test hypotheses have been evaluated. The structural model evaluation gives an understanding of the ability of the theoretical model to define the variance of the endogenous variables and the accomplishment of the hypothesized relationships.

The coefficient of determination (R^2) shows the percentage of variance in endogenous constructs explained by their predictors. Hair et al. (2017) explain that a 0.75, 0.50 and 0.25 R^2 value is strong, moderate, and weak explanatory power respectively in PLS-SEM research. The research model as it is discussed in Table 7 shows that both endogenous constructs have a high explanatory power. The R 2 of Employee Performance is 0.619, which implies that Succession Planning Quality and Successor Leadership Style jointly predict a value of about 61.9% of the variation in Employee Performance. This implies that the quality of succession planning processes and leadership behaviors exhibited by successors play an important role in the performance of employees in case of succession transitions, whereas the rest 38.1% is credited to other unspecified factors outside of the scope of this model. Organizational Performance reveals a greater R^2 value of 0.703, which shows that Succession Planning Quality, Successor Leadership Style, and Employee Performance all of the Succession Planning Quality, Successor Leadership Style, and Employee Performance are used to explain the variance of 70.3% in Organizational Performance. Such a large explanatory power is indicative of the fact that the research model successfully explains the major component factors that affect organizational performance in unfolding leadership succession in family clinics.

Table 7: Coefficient of Determination (R^2)

Endogenous Variable	R^2	R^2 Adjusted
Employee Performance	0.619	0.615
Organizational Performance	0.703	0.699

Bootstrapping procedures were used to calculate the significance of path coefficients by applying 5,000 subsamples to test the hypothesis. The critical t -value of a two-tailed t-test at = 0.05 is 1.96, i.e., path coefficients with t -values greater than 1.96 or p -values less than 0.05 are statistically significant. The test results of the hypothesis (direct effects and indirect effects) of the mediation analysis are given in Table 8.

Table 8: Hypothesis Testing Results

Hypothesis	Path	Path Coefficient	T-value	P-value	Result
H1	SPQ → OP	0.445	5.008	0.000	Supported
H2	SPQ → EP	0.467	5.470	0.000	Supported
H3	SLS → EP	0.380	4.162	0.000	Supported
H4	SLS → OP	0.403	5.014	0.000	Supported
H5	EP → OP	0.064	0.871	0.384	Not Supported
H6	SPQ → EP → OP	0.030	0.854	0.393	Not Supported
H7	SLS → EP → OP	0.024	0.772	0.440	Not Supported

Note: SPQ = Succession Planning Quality; SLS = Successor Leadership Style; EP = Employee Performance; OP = Organizational Performance

The results reveal that four out of seven hypotheses are supported. Hypothesis 1, which proposes that Succession Planning Quality has a positive effect on Organizational Performance, is supported ($\beta = 0.445$, $p < 0.001$). This indicates that higher quality succession planning processes directly contribute to better organizational performance in family clinics undergoing leadership transition. Hypothesis 2, proposing that Succession Planning Quality has a positive effect on Employee Performance, is also supported ($\beta = 0.467$, $p < 0.001$). This represents the strongest path coefficient in the model, suggesting that well-designed succession planning processes significantly enhance employee performance by providing clarity, reducing uncertainty, and demonstrating organizational commitment to smooth leadership transitions.

Hypothesis 3, which posits that Successor Leadership Style has a positive effect on Employee Performance, is supported ($\beta = 0.380$, $p < 0.001$). This indicates that successors who demonstrate transformational leadership behaviors positively influence employee performance during the transition period. Hypothesis 4, proposing that Successor Leadership Style has a positive effect on Organizational Performance, is also supported ($\beta = 0.403$, $p < 0.001$). This finding confirms that transformational leadership behaviors demonstrated by successors directly contribute to organizational performance outcomes during succession transitions.

However, Hypothesis 5, which proposes that Employee Performance has a positive effect on Organizational Performance, is not supported ($\beta = 0.064$, $p = 0.384$). Despite the positive direction of the coefficient, the relationship is not statistically significant, suggesting that in the context of family clinic succession, the direct influence of employee performance on organizational performance is minimal when accounting for the direct effects of succession planning quality and successor leadership style. Consequently, the mediation hypotheses are also not supported. Hypothesis 6, proposing that Employee Performance mediates the relationship between Succession Planning Quality and Organizational Performance, is not supported ($\beta = 0.030$, $p = 0.393$). Similarly, Hypothesis 7, proposing that Employee Performance mediates the relationship between Successor Leadership Style and Organizational Performance, is not supported ($\beta = 0.024$, $p = 0.440$). These results indicate that the effects of Succession Planning Quality and Successor Leadership Style on Organizational Performance operate primarily through direct pathways rather than through the indirect mechanism of Employee Performance.

5. Discussion

This study has explored how the quality of succession planning and the leadership style of the successor affects the organizational performance using the employee performance as a mediating variable in the case of family clinics in Indonesia that undergo first-to-second generation leadership transitions. The results offer valuable theoretical and practical implications on the effect of succession planning and leadership factors on performance outcomes of leadership change in family healthcare businesses.

The fact that the quality of succession planning has a considerable and positive contribution to organizational performance supports the hypotheses of the Resource-Based View Theory, which makes high-quality succession planning a strategic organizational resource that creates sustainable competitive advantage. The result is in line with Kim (2012), who revealed that organizations that have a better foundation of succession planning are better placed to sustain operating conditions and bottom-line performances to give competitive advantages in the healthcare markets. It is also consistent with the outcome of Hermes et al. (2025) who concluded that systematic succession planning is essential in enhancing leadership stability, minimizing recruitment expenditures, and resilience of the organization in healthcare institutions. When dealing with family clinics, the quality of succession planning becomes primary due to the necessity to retain the quality of the service, patient trust, and economic performance after changing the leadership styles of the founder-doctor and professional managers.

The positive correlation between the quality of succession planning and employee performance is significant enough to give the Social Exchange Theory much support since, under the assumption that the organizations invest in the quality of systematic succession planning, the employees are convinced that the organization is interested in the stability of the leadership and in the opportunity to grow their careers and develop, which makes them feel obliged to return the favor by exerting more effort and performance in the work. This result aligns with that of Desarno et al. (2020), who detected that succession planning leads to employee engagement and employee retention due to competent career management, which maximizes the needs and aspirations of employees. The outcome is also contrary to Thomas et al. (2025), who proved that incomprehensive succession and inefficient transition management led to employee demotivation, turnover, and lack of engagement. The existing research is the flip-side of this interaction, indicating that a well-designed succession planning improves and, instead of degrading, employee performance through a reduction in uncertainty and the lack of organizational orientation in the periods of transition.

The propositions of the Transformational Leadership Theory are supported by the positive and significant impact of the successor leadership style on the organizational performance, which, in turn, proves the relevance of the effective leadership in the context of healthcare succession. This outcome is consistent with Alshammari et al. (2024) who discovered that transformational nursing leadership can help healthcare organizations in terms of resources management, quality of care, and sustainability. The outcome also backs up Ganesan et al. (2025), who demonstrated that the effectiveness of leadership using systematic development of leadership programs leads to the improvement of the performance of organizations in a healthcare context. Successors with transformational leadership can also effectively convey powerful visions relating the past with the future, engage employees in change procedures to minimize resistance, and continue to provide quality services through the transition periods, which is relevant in the context of family clinic succession.

The observation that successor leadership style has a positive and significant impact on employee performance is not new given the vast previous research on transformational leadership in healthcare establishments. This finding will confirm Alshaabani et al. (2021), who concluded that transformational leadership has a positive impact on the performance of healthcare professionals and administrative personnel irrespective of their exact roles. The result is also consistent with that of Durowade et al. (2020), who revealed that the transformational leadership type exhibited the greatest impact on job satisfaction compared to other leadership styles, and the transformational strategies motivated health workers to offer improved healthcare services. Equally, this finding is similar to that of Wong et al. (2013), who demonstrated that transformational leadership is associated with job satisfaction and patient safety outcomes among nurses due to structural empowerment. Successors in the family clinic setting are better in preserving and improving performance of employees in the tough transition period; they do so by offering

a personalized coaching and support, promoting creative thinking, and instilling excitement over organizational objectives.

The impact of employee performance on organizational performance was unstatistically significant, which was not expected based on the theoretical assumptions, and it is also an unexpected finding that should be interpreted with a great deal of attention. This finding is contrary to those of Thomas et al. (2025), who established that staff demotivation and disengagement were detrimental to health system performance, and Alshaabani et al. (2021), who revealed that employee performance mediates the correlation between transformational leadership and organizational performance. This finding can be explained by a number of reasons. First, when considering family clinic succession, the quality and successor leadership style of succession planning may have such a powerful impact on the organization performance that the indirect route through employee performance is not noticeable. Second, the particular environment of family clinics that experience first to second generation succession could have its own dynamics whereby organizational performance is more directly influenced by the factors of leadership and planning in comparison with the aggregated performance of employees. In a shift of succession, the strategic choices of new personnel and the success of the process of transition can have a greater impact on the organizational performance measures in comparison to the changes in the performance levels of individual employees in an incremental manner.

The results that the performance of employees does not play a significant role in mediating the relationship between succession planning quality and organization performance and successor leadership style and organization performance are problematic to the traditional theory that succession and leadership variables can determine the success of organizations. The implication of these findings is that in family clinic succession settings, the impact of the quality of succession planning and the style of leadership successor on organizational performance follow mainly direct routes instead of acting through employees. This observation is contrary to the theorical expectation of the Social Exchange Theory that indicates that such organizational investments as succession planning and effective leadership must have an effect on the performance of organizations due to their impact on the attitudes and behavior of the employees. Nevertheless, the findings are not completely contrary to the previous studies, with Haveman et al. (2001) discovering that leadership change and changes in organizational domains directly influence the following performance, and it is not always essential to consider the mechanisms of change at an employee level. The lack of large mediation effects could indicate the peculiarities of the family clinic succession when the organization performance in the period of transition can be more directly influenced by such aspects as the preservation of relationships between the founder and the key patients, preservation of clinical reputation, the continuity of the operational systems, and trust of the external stakeholders.

6. Conclusion

This study has investigated the relationship between the quality of succession planning and the style of successor leadership and the performance of an organization using employee performance as a mediating factor in familial clinic organizations that have undergone first to second generations leadership transition in Indonesia. The results demonstrate that the quality of succession planning has a significant and positive impact on the organizational performance and employee performance, which proves the strategic role of the systematic succession procedures in the family healthcare companies. Similarly, the style of successor leadership proves to have a strong positive influence on the organizational performance, and employee performance, which confirms the applicability of the transformational leadership behaviors within the succession transition. Nonetheless, the employee performance does not have a significant influence on the organizational performance and, therefore, does not mediate the relationships between the independent variables and the organizational performance. These results imply that the quality of succession planning and the leadership style of the successor have direct relationships with the organizational performance in the presence of a succession context in the family clinic instead of acting on the paths mediated by employees.

The research gives value to succession planning and leadership literature because it indicates that these two variables are strategic organizational capabilities that have a direct impact on organizational performance in family healthcare business environments. These results would suggest that the theoretical direction in which employee-

level factors mediate the effects of succession to family clinic facilities might not be applicable in conventional Social Exchange Theory applications. In practice, the focus of investment in high quality succession planning procedures and building transformational leadership skills in successors should be among the strategic initiatives by the family clinic owners, which has direct performance consequences. Idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration should be focused in successor development programs to achieve effective leadership in the course of transitions.

There are a number of limitations that should be considered. The study is limited to the Indonesian family clinics that experience the first-second generation succession, which restricts the extrapolation of the findings to the other situations. The cross-sectional design will only take the impressions at one point in transitions and it may fail to capture the long-term effects. Longitudinal designs should be used in the future to determine how these relationships change across various succession stages, explore other potential mediating variables like stakeholder trust and reputation of the organization, and carry out comparative studies on various industries and cultures to better understand the boundary conditions of the results.

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Data Availability Statement: The data supporting this study are derived from survey responses collected from family clinic employees and successor leaders in Indonesia. Due to confidentiality agreements and the sensitive nature of succession-related information, raw survey data cannot be publicly available. Anonymized analytical data and aggregated results are available from the corresponding author upon reasonable request.

Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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Implementing Sustainability Budget Tagging in ERP Systems: Evidence from Indonesia's State-Owned Energy Company

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Abstract
Enterprise Resource Planning (ERP) systems are becoming strategic platforms for integrating sustainability metrics, though there are substantial gaps in operationalizing sustainability cost tracking within current financial frameworks. This paper explores how Sustainability Budget Tagging (SBT) can be implemented in SAP ERP at PT Pertamina and the key challenges in tracking and reporting sustainability spending. Before implementation, manual sustainability cost tracking at Pertamina took around 120 person-hours per year (only 85 percent accurate) and did not provide decision-makers with much real-time visibility. In a single-case study approach with a holistic design in which the before-and-after comparison is embedded, this study documents the end-to-end implementation process across four phases: baseline assessment, system design and development, phased deployment, and post-implementation evaluation. The data were collected through semi-structured interviews with 15 stakeholders, document analysis, SAP system logs, and dashboard artifacts. The findings show a significant positive change: a 30% decrease in reporting preparation time, a 10% increase in the accuracy of cost tracking, and a 75% decrease in budget allocation error. The research provides empirical data on ERP-supported sustainability accounting in new-economy state-owned firms. It serves as a useful guideline for designing a taxonomy, setting up SAP modules, and managing the organization during sustainability tracking implementation.

Keywords: Sustainability Budget Tagging, Enterprise Resource Planning, Environmental Management Accounting, State-Owned Enterprise, ESG Reporting, SAP

1. Introduction

The worldwide trend toward corporate sustainability has radically changed how organizations conceptualize value creation and accountability. Enterprise Resource Planning (ERP) systems, which were traditionally aimed at maximizing the effectiveness of business operations, now have a strategic task of integrating environmental, social, and governance (ESG) metrics into business processes (Alzahmi et al., 2025; Chofreh et al., 2016). Still, even with increased awareness of the importance of sustainability, there remains a major infrastructure disparity in how organizations systematically track, manage, and report on sustainability-related spending, especially in the context of traditional ERP architectures where ESG concerns were largely discretionary (Barker, 2025).

The emerging economies' state-owned enterprises (SOEs) experience acute pressures at this intersection in particular. Such organizations have to deal with two mandates: commercial performance requirements and developmental goals that indicate the state ownership (Bruton et al., 2015; Musacchio et al., 2015). In the energy sector, state enterprises are facing mounting pressure regarding climate pledges and the open use of significant funds for renewable energy sources and emissions mitigation (Sundarasen et al., 2024). The mismatch between ambitious environmental sustainability policies and the ability to systematically monitor these investments jeopardizes credibility when stakeholder demands for ESG accountability are as high as ever before.

The failure to systematically monitor sustainability costs leads to domino effects. Companies that fail to implement integrated tracking resort to labor-intensive, resource-consuming manual procedures that do not yield credible data. The accuracy of this manual method is usually 80-85 percent, there is 15-25 percent inconsistency in classification, and it takes hundreds of person-hours to complete a reporting cycle (Burritt et al., 2023; Gerged et al., 2024). Retrospective tracking denies management real-time visibility, which reduces the likelihood of resource allocation in an ad hoc fashion. In addition, sustainability reporting, which was previously a voluntary act, has been made mandatory through increased ESG disclosures, rendering it a legally binding disclosure that must be audited by external auditors (Barker, 2025). The IFRS S1 and S2, introduced by the International Sustainability Standards Board and used by many jurisdictions such as Indonesia, starting January 2027, require climate-related financial disclosures to be prepared in an audit-ready form with documentation trails generated by the system (IFRS Foundation, 2023). Companies that fail to disclose systematic sustainability costs are fined by the government and perceived as cynical by stakeholders, which negatively affects the organization's image and increases capital expenditures.

In addition to compliance, insufficient visibility into the cost of sustainability prevents organizations from answering the most basic strategic questions: Which programs have the greatest impact for the dollars invested? Is the actual spending in relation to the budgets? What is the percentage of capital expenditure that is truly progressive towards sustainability objectives? The management will be unable to assess cost-effectiveness or redistribute resources to more significant prospects without granular, timely data associated with performance outcomes (Schaltegger and Burritt, 2000).

The overlap between sustainability management and ERP systems has generated significant academic interest, though major gaps remain. The conceptual frameworks of the sustainability ERP (S-ERP) study have identified a positive correlation between S-ERP implementation and organizations' sustainability performance (Chofreh et al., 2016, 2020; Abobakr et al., 2024). Nevertheless, the current literature has focused more on S-ERP at the system level and has insufficiently revealed particular mechanisms that implement sustainability in ERP architectures (Jaradat et al., 2025; Yurtay, 2025). One such mechanism is budget tagging, which, however, is not well researched. Although it is widely used in the public sector, budget tagging for corporate sustainability management is a new practice with limited academic literature (Welham et al., 2020; Gerged et al., 2024). There is virtually no empirical research on the implementation of budget tagging, and the available research on the concept focuses on the concept in theory rather than on the design of taxonomies, technical integration, and effectiveness implications.

There are three more limitations in the current S-ERP research. To begin with, empirical research shows a developed-economy bias, with the main focus on European and North American organizations (Abobakr et al., 2024; Alzahmi et al., 2025). Second, the extant literature is saturated with studies of private corporations. In contrast, SOEs are a major part of the economy, managing an estimated third of corporate resources in emerging markets (Musacchio et al., 2015). Third, the energy sector is also characterized by underrepresentation, even though sustainability issues are particularly severe (Sundarasen et al., 2024).

The research addresses these gaps by discussing the implementation of Sustainability Budget Tagging (SBT) in the SAP ERP system of PT Pertamina. As a case with several under-researched features (a state-owned enterprise engaged in the energy industry in an emerging market (Indonesia)) with increased sustainability reporting demand yet having developed ERP systems, Pertamina is a critical case (Yin, 2018). As the largest energy company in Indonesia, Pertamina has committed to achieving 31% renewable energy consumption and 29% greenhouse gas reduction by 2050, which translates to about USD 120 billion in sustainability investments. Before the

implementation of SBT, sustainability cost tracking relied on disjointed manual processes that required about 120 person-hours per year to generate data of poor quality and with poor real-time visibility.

The research investigates five interconnected questions: How does SBT enhance transparency and accountability? What technical and non-technical challenges emerge during implementation? To what extent does SBT impact regulatory compliance and ESG value? How effective are specific ERP modules in supporting SBT? How do Power BI dashboards aid monitoring and strategic decision-making?.

2. Literature Review

2.1 Enterprise Resource Planning (ERP) Systems

Enterprise resource Planning (ERP) systems are integrated software platforms that consolidate main business activities in functional domains into one database architecture, as opposed to the divided and fragmented legacy systems that are used, which provide consolidation infrastructure that allows real-time data availability and cross-functional coordination (Monk and Wagner, 2013; Seddon et al., 2010). ERP systems were developed as an improvement on Materials Requirements Planning systems of the 1970s, evolving into modern fifth-generation systems based on cloud computing and artificial intelligence, such as the in-memory computing architecture of SAP S/4HANA (Lehnert et al., 2023). As much as there might be positive aspects, implementations have a significant amount of challenges due to twin technological and organizational transformational demands, and the key success factors involve the support of the top management, the efficiency of project management, and the management of organizational change (Luo and Strong, 2004; Shaul and Tauber, 2013). The introduction of sustainability functionality represents a new dimension, and regulatory demands and organizational pledges are driving the development of sustainability modules, including carbon accounting, energy management, and ESG reporting (Alzahmi et al., 2025; Yurtay, 2025).

2.2 Sustainable ERP (S-ERP)

Sustainable ERP (S-ERP) is an extension of conventional ERP that incorporates environmental, social, and governance issues into core business processes (Chofreh et al., 2016). The framework by Chofreh et al. (2016) has three basic dimensions: environmental (energy and emissions tracking), social (labor practices and community engagement), and governance (transparent reporting and compliance). Empirical evidence shows that S-ERP implementation produces far-reaching economic, environmental, and social performance improvement, which is mediated by the ability to collaborate with the supply chain (Abobakr et al., 2024). Nevertheless, there are significant obstacles to implementation, such as the complexity that demands interdisciplinary skills, the high cost of implementation that is not restricted to software licensing, and the challenge of organizational readiness, which can be particularly severe in emerging economies (Alzahmi et al., 2025). One of the most important gaps is the mechanisms for capturing sustainability data within ERP transactional processes, with less literature examining the technical design of data-capture mechanisms such as budget tagging schemas (Jaradat et al., 2025).

2.3 Budget Tagging for Sustainability

A budget is an orderly program that assigns categorical identifiers to financial transactions so expenditures can be tracked and reported with respect to specific goals (Downes et al., 2017). Although it is widely used in the public sector, the use of the tool in corporate sustainability management is a nascent practice with limited scholarly literature (Welham et al., 2020). The theoretical basis is the principles of activity-based costing, which allow organizations to attribute environmental and social costs to particular activities by categorizing sustainability classifications within the system of transaction processing (Cooper and Kaplan, 1988; Swalih et al., 2024). There are significant benefits to integrating with ERP systems: budget tags are required fields that ensure full data representation, automated validation logic imposes requirements, and integration will allow connecting expenditure data with physical sustainability performance data (Weerasekara and Gooneratne, 2023; Jaradat et al., 2025). Such challenges as user compliance issues, data quality problems, and retrospective application issues are present (Alsayegh et al., 2020; James, 2015). The empirical research is limited, and most applications are in the

governmental context, raising questions about feasibility in the corporate context, specifically in state-owned enterprises in emerging economies (Gerged et al., 2024; Qian et al., 2018).

The above-reviewed theoretical background and the available empirical literature form the conceptual framework for exploring Sustainability Budget Tagging implementation at PT Pertamina. Figure 1 shows the research design used in this study.

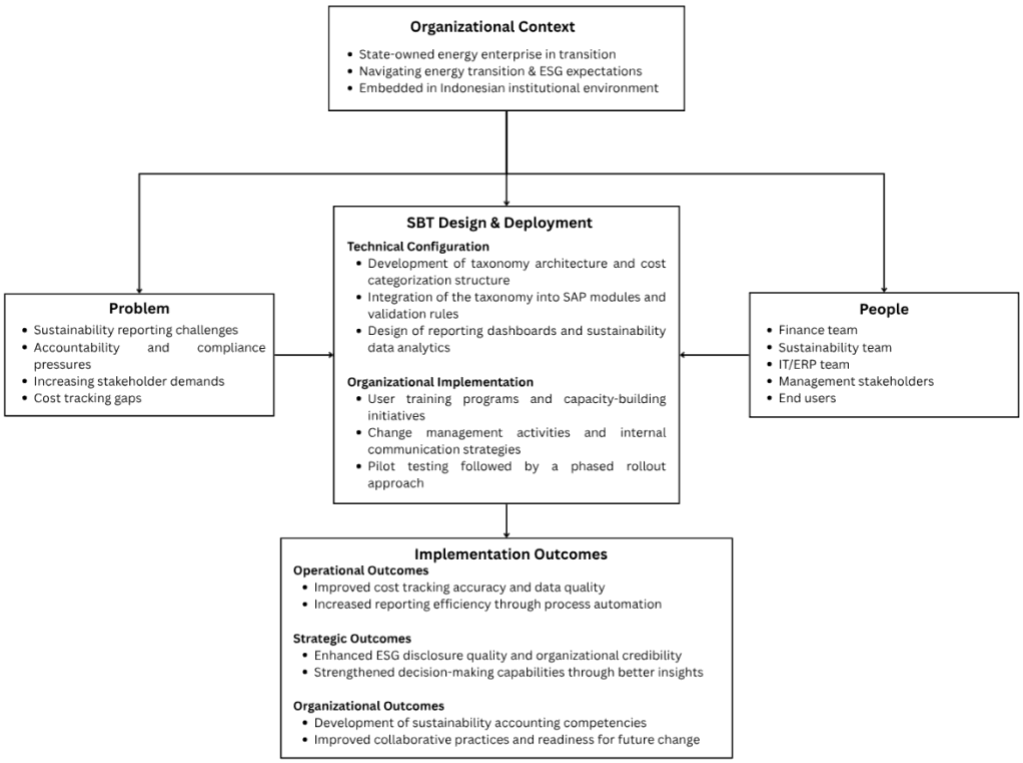

Figure 1: Research Framework

3. Methods

3.1 Research Design

This research employs a holistic single-case study design with embedded units of analysis, incorporating systematic before-and-after comparison to examine the implementation of Sustainability Budget Tagging (SBT) at PT Pertamina (Yin, 2018). The single-case approach is justified on three grounds: revelatory access to an implementation process rarely documented in the academic literature, critical case characteristics that enable theoretical testing, and longitudinal access that permits comprehensive documentation across all implementation phases (Figure 2).

Case Selection Rationale

PT Pertamina represents a **critical case** (Yin, 2018) for examining ERP-supported sustainability tracking due to several theoretically significant characteristics. First, as Indonesia's largest state-owned energy company, managing USD 120 billion in sustainability investments through 2040, Pertamina faces acute pressures at the intersection of commercial performance requirements and developmental mandates characteristic of emerging-economy SOEs (Bruton et al., 2015; Musacchio et al., 2015). Second, the energy sector context—where sustainability costs are substantial and increasingly subject to regulatory scrutiny—represents a domain where systematic tracking mechanisms are critically needed yet empirically underresearched (Sundarasen et al., 2024). Third, Pertamina's mature ERP infrastructure (MySAP ECC 6.0 implemented enterprise-wide since 2015)

provides a stable platform for examining sustainability integration without the confounding effects of concurrent system implementations. Fourth, the impending regulatory deadline of Indonesia's mandatory Sustainability Disclosure Standards (January 2027) creates institutional pressures that mirror global trends toward mandatory ESG reporting, enhancing the transferability of findings to similar regulatory contexts.

The implementation addresses three interconnected organizational challenges that characterize the research problem: (1) Process inefficiency – manual sustainability cost tracking requiring approximately 120 person-hours annually with only 85% accuracy and limited real-time visibility; (2) Strategic visibility gap – inability to systematically monitor USD 120 billion in planned sustainability investments or answer basic allocation questions (Which programs deliver highest impact per dollar invested? Is actual spending aligned with budgets? What percentage of capital expenditure genuinely advances sustainability objectives?); and (3) Compliance pressure – escalating regulatory requirements for audit-ready sustainability cost documentation under Indonesia's forthcoming disclosure standards aligned with IFRS S1 and S2 frameworks.

Unit of Analysis Structure

The primary unit of analysis is the SBT implementation process at the enterprise level, encompassing the full lifecycle from baseline assessment through institutionalization. Embedded units of analysis provide multiple perspectives within the holistic case (Yin, 2018), structured across three dimensions: (1) Organizational units – specific business divisions (upstream exploration, midstream refining, downstream distribution, corporate functions) experiencing varying degrees of sustainability cost complexity; (2) Technical units – individual SAP modules (Materials Management, Controlling, Financial Accounting, Project System) requiring distinct configuration approaches; and (3) Stakeholder units – functional roles (finance staff, sustainability managers, procurement personnel, IT specialists, senior management) with differentiated system interactions and information needs. This embedded structure enables pattern-matching across multiple contexts while maintaining a holistic understanding of the enterprise-level implementation.

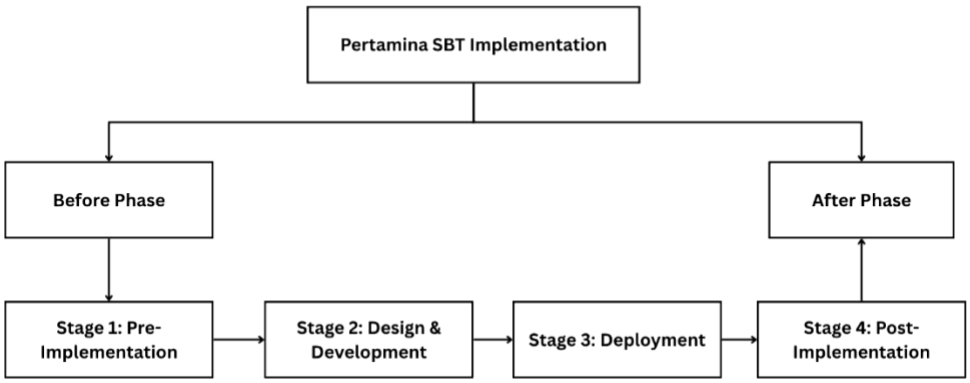

Figure 2: Research Design

3.2 Data Collection

The research uses various data collection methods to gain a deep understanding and enable triangulation of results, including interviews, documentation, archival data, and physical evidence (Yin, 2018). The main approach is semi-structured interviews, which will be conducted in three stages: baseline (current practices and challenges), implementation (emerging experiences and adaptation), and post-implementation (outcomes and learning). Participants are purposively sampled across organizational functions, hierarchical levels, and business units until thematic saturation is achieved (Patton, 2015). The interview protocols are designed to suit the stakeholder groups, as illustrated in Table 1.

Table 1: Interview Protocol by Stakeholder Group

Stakeholder Group	Key Focus Areas
IT & ERP Implementation	Technical challenges, data consistency, customization needs, and dashboard integration
Finance & Accounting	Reporting accuracy/speed, ESG compliance, system limitations
Sustainability / CSR	Support for sustainability goals, planning/monitoring, framework alignment
Procurement / Material Management	Sustainable procurement practices, vendor selection, and tracking accountability
General Managers	Budget visibility, strategic decision-making, stakeholder expectations
Compliance & Regulatory	Regulatory compliance effectiveness, reporting challenges

All interviews are conducted in either Indonesian or English, audio-recorded with informed consent, transcribed word-for-word, and coded anonymously using role-based codes. The interview lasts between 45 and 90 minutes. The analysis of the documents investigates organizational artifacts such as financial reports, sustainability reports (2022-2024), budget allocation documents, regulatory guidelines, meeting minutes, Scrum sprint documentation, executive presentations, training materials, SAP configuration specifications, project plans, reports on external benchmarking, and documents on GRI Standards (Yin, 2018). Archival records offer quantitative information on systematic before-after comparison using SAP system logs on the evaluation of the frequency of use, the volume of transactions, the percentage of tagging (100) and the rate of errors (11), the use of data in the dashboard (time logs), and the completeness of the data (cross-referencing program inventories to documented costs). Physical documents such as system screenshots, dashboard displays, configuration printouts, and taxonomy documents are actual materials that demonstrate system capabilities and technical specifications.

3.3 Data Analysis

3.3.1 Qualitative Data Analysis

Qualitative analysis gives meaning to the textual data from interviews, documents, and artifacts to comprehend stakeholders' experiences, how the implementation process unfolds, and the organization's dynamics. Thematic analysis has been used because it is a systematic process, as described in the six-phase system proposed by Braun and Clarke (2006): familiarization with data, by repeated reading, initial coding of meaningful segments, search for themes, based on the similarity of related codes, reviewing of themes, definition and naming of themes, and the final analysis. The coding methodology involves a mixture of deductive codes based on the conceptual structure (institutional pressures, technological factors, organizational factors, outcomes) and inductive codes that emerged immediately after the data, providing an analysis that is empirically based and theoretically guided. NVivo is used to conduct coding, and all decisions made during the coding process are recorded in researcher memos. Process tracing is used alongside thematic analysis to record causal processes between implementation activities and observed outcomes, forming detailed, chronological accounts of the order in which certain actions produced consequences through particular mechanisms (Bennett and Checkel, 2015). Narrative analysis focuses on how stakeholders make meaning by telling stories of their experiences, paying attention to the structure of narratives, such as how individuals package pre-implementation frustrations, implementation difficulties, and adjustments, and to post-implementation analysis (Clandinin and Connelly, 2000).

3.3.2 Quantitative Data Analysis

Quantitative analysis provides objective evidence of the SBT implementation's impact by systematically comparing financial data and system usage metrics. Descriptive statistics are used to summarize important variables, including measures of central tendency (mean, median) and measures of dispersion (standard deviation, range) for cost tracking accuracy percentages, preparation time to report in hours, and data completeness percentages. Before-and-after comparison also uses the right statistical tests: paired t-tests determine whether the post-implementation means differ significantly compared to pre-implementation baselines in a continuous variable, such as the reporting preparation time, and chi-square tests or McNemar's tests compare the proportion

of categorical outcomes, such as the accuracy in classifying a transaction (Field, 2013). The calculation of the effect size via Cohen's d determines the magnitude of change above the level of statistical significance, which is useful for assessing significance. Longitudinal trend analysis is performed to determine whether the improvements are persistent or transient by monitoring measures at multiple time points after implementation. Quantitative analysis involves statistical computation in SPSS or R and data visualization in Excel, using charts and graphs to represent comparisons before and after and trends over time.

3.3.3 Mixed Methods Integration and Triangulation.

Mixed-methods integration combines qualitative and quantitative data to yield comprehensive knowledge that neither method alone would have been capable of extracting (Creswell and Plano Clark, 2018). The comparison of evidence provided by other parties of interest (finance versus sustainability views), data types (interviews versus observations versus documents), and time (baseline versus interim versus post-implementation) is known as source triangulation. Method triangulation focuses on the congruence of qualitative themes with quantitative patterns, such as whether themes of interview data on better accuracy are correlated with statistical improvement in audit findings. Multi-perspectival interpretation is achieved through the use of the technology acceptance model, institutional theory, sustainability accounting theory, and other theoretical models in theory triangulation to analyze the findings (Denzin, 2012). Convergent analysis prepares joint display tables of qualitative and quantitative results next to one another in each research question, making a graphical representation of convergent (both sources point to the same conclusion), complementary (data points to different aspects), and divergent (data points to different conclusions) sources. Meta-inferences are higher-order interpretations that are integrated across all data sources and methods of analysis, answer research questions more holistically than any single data source alone, and are an example of the added value of mixed-methods design (Tashakkori and Teddlie, 2010).

4. Results

4.1 Pre-Implementation Phase

Before the implementation of Sustainability Budget Tagging (SBT), sustainability cost tracking at Pertamina relied on manual processes, which posed significant challenges for internal management and external reporting. The enterprise resource planning system consisted of MySAP ECC 6.0, implemented enterprise-wide since 2015, with major modules including Financial Accounting (FI), Controlling (CO), Materials Management (MM), Plant Maintenance (PM), and Project System (PS). Although this architecture provided sufficient support for traditional financial management, it offered no native support for systematic identification or classification of sustainability costs. The finance functions retained the key role of budget management through SAP systems, and the sustainability function, located in Corporate Affairs, retained responsibility for ESG strategy development and external interaction. This structural division produced operational disconnects, ranging from reporting inefficiency to basic rifts in sustainability and financial visibility.

The organization hierarchy and project management needs served as the basis for cost centers and internal orders rather than the logic of the sustainability program. Sustainability costs were allocated across hundreds of cost centers, including upstream exploration, midstream refining, downstream distribution, and corporate functions, without a uniform classification mechanism to enable aggregation of sustainability reporting. The staff of the Finance Department described the limit:

"The system we had wasn't designed with sustainability in mind. We could track costs by department, by project, but asking 'how much did we spend on renewable energy?' those questions required starting from scratch every single time."

The disconnection between systems, necessitated by the annual sustainability reporting cycle required by OJK Reg., required intensive manual reconciliation. No. 51/2017 and the Ministry of SOE ESG performance evaluations. It normally began three months after the fiscal year-end, and sustainability teams assembled a complete program inventory at that point, which was sent to the finance teams, who then tried to determine which

costs were covered by the program using custom queries based on keyword searches in the cost element descriptions and internal order names. First data pulls usually gave out thousands of transactions that had to be vetted by hand to identify whether sustainability was actually relevant, and about thirty to forty percent of the data were ambiguous cases that needed to be discussed with the budget holder or had to be passed on to sustainability managers.

The baseline performance measures were set across various dimensions to develop demanding benchmarks for assessing the outcomes of SBT implementation. Performance appraisal of sustainability budget reporting efficiency indicated that the average time spent in preparing the report was 10 working days for a full-time dedicated analyst (excluding the time of budget holders and other assisting staff in the business units). The accuracy in reporting was about eighty-five percent on correct identification and categorization, with the error rate about fifteen percent in the form of false positives (expenditures incorrectly labelled as sustainability-related), false negatives (true sustainability expenditures missed during screening), and mismatched categories (correctly identified but classified under the wrong dimensions of the 5P). Mistakes in budget allocation averaged 20 high-profile cases each fiscal year, and the mistakes were related to misappropriation of expenditures, duplication of counts, or incomplete capture, which was only revealed when compiling annual reporting at the end of the fiscal year. Transparency in reporting is 70%, indicating low granularity in traditional reports, long-term periods, and an inability to provide verification documentation (Table 2).

Table 2: Baseline Performance Metrics

Indicator	**Baseline Measurement**	**Performance Gap Description**
Real-Time Budget Monitoring Capability	50%	Limited access to current information without special requests
Decision-Making Speed	60%	Information delays constrain timely resource allocation adjustments
Accuracy of Information Used in Decisions	70%	Data quality concerns are reducing confidence in management reporting
User Satisfaction with Dashboards	65%	Recognition of significant improvement potential based on peer practices
Frequency of Dashboard Usage in Decision Processes	40%	Low utilization reflecting access difficulties and quality concerns

Environmental compliance was at 80 percent, social compliance at 75 percent, and ESG reporting on time at 60 percent, indicating operational issues that necessitated constant deadline extensions. The challenge was characterised by compliance and Regulatory Affairs staff:

"Meeting ESG reporting deadlines was a constant struggle. We'd start the process thinking we had adequate time, but then data collection would take longer than expected, classifications would need revision, and validations would reveal errors requiring rework. We were perpetually asking for extensions and explaining delays to regulators."

The sustainability initiatives reached 65%, indicating issues with program implementation and the inability to track costs due to disconnected systems. Assessment of the ERP system revealed that the Material Management module is functioning at 70% effectiveness; that is, there are no systematic mechanisms for identifying sustainable procurement opportunities. The workers of the Procurement Department demonstrated the problem:
"We had general guidance about preferring environmentally friendly options, but no systematic way to identify which purchases were for sustainability programs or which vendors met sustainability criteria. It was ad hoc and depended on individual buyer awareness rather than system support."

Module controlling had an 80% effectiveness, Financial Accounting had an 85% effectiveness, and integration effectiveness was 75%. The level of user satisfaction was 65%, due to the frustration with manual workarounds. The evaluation of business intelligence and decision support capability showed that real-time budget monitoring

was at half the target, and decision-making speed was at 60% of the target. General Manager employees referred to the visibility issue:

"When Board members asked about sustainability spending in specific areas, we couldn't give immediate answers. We'd have to go back to finance, wait for them to compile data, then hope the numbers were accurate. By the time we had solid information, the strategic moment for decision-making had often passed."

The accuracy of the information obtained was 70%, user satisfaction was 65%, and dashboard use was 40%. These overall baseline results showed that step-by-step improvement would not be sufficient to address structurally inherent constraints, which is a strong reason to implement a systematic intervention by tagging sustainability budgets through ERP.

4.2 Design and Development Phase

The Sustainability Budget Tagging (SBT) taxonomy was created as a first-class semantic attribute to address the prevailing need for definition in Materials Management (MM), rather than an after-the-fact reporting tag. The fundamental architectural choice articulates the tag as a managed Item Text ID on the line of the Purchase Requisition (PR), characterizing sustainability indicators for each requested good or service as components of the primary data in the transaction, rather than being subsequently rebuilt based on the cost report. The system also allows a single requisition to include lines for both sustainability-attributable and non-attributable items without losing granularity, since the taxonomy is anchored at the PR item level, and the tag is a persistent property that can be validated and reported throughout the procurement lifecycle.

The architecture defines three fundamental designs in the procure-to-pay process. Initially, on the PR level, the PR item text type is developed in the customizing layer of SAP. It is called the Asset Integrity Budget Tag and has two functions: making the item visible to business personnel on the PR screen and serving as a consistent technical handle for validation and reporting.

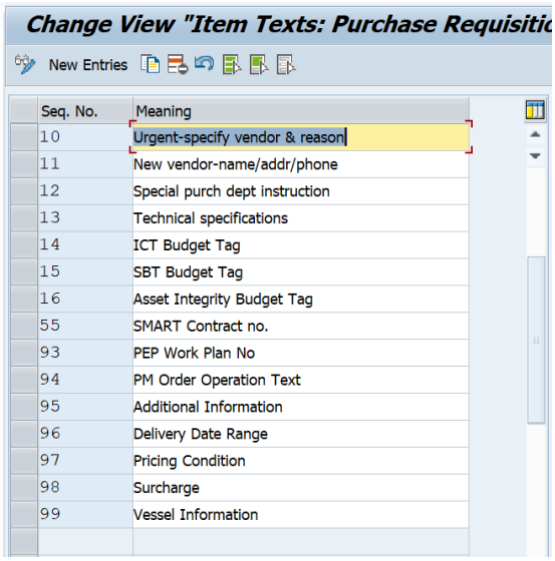

Figure 3: Text Type

Rules that are copied are selectively coupled with semantics to bind document flow, and this is used to teach the SAP to copy the SBT text to subsequent documents without hand re-entry. The mechanism is a governance control that helps prevent semantic drift and ensures there is only one source of truth across PR→RFQ→PO transitions. Second, this architecture pattern is reused at the RFQ level, establishing the same text types at the RFQ item level, allowing inherited tags to be viewed and verified, and copying rules ensure that an RFQ created on a tagged PR line shows the same SBT text. Third, the PO stage involves changing the taxonomy intention into formal commitment, and it is where the sustainability meaning is embedded in the legal and accounting commitments at the time the obligations are made.

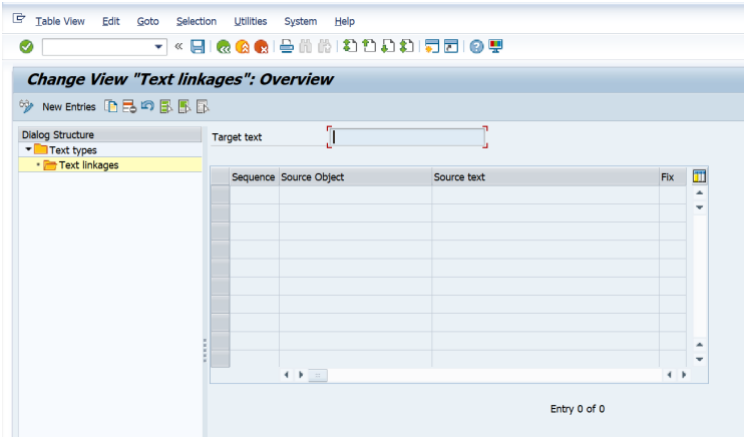

Figure 4: Copying Text

The taxonomy is not just a front-end label, but a controlled code system, the validity of which is determined by the accounting context to which the line represents. When the account assignment and cost element point to a sustainability-mapped cost object, the PR item tag is mandatory. If the code is undefined, it is blocked and flagged when multiple account assignments are not consistent with the tagging rules. This conduct is recorded via purpose-designed error and warning messages (Table 3), which ensure data quality at save/check and notify users of errors in real time. A template-conscious activation system addresses enterprise heterogeneity during the transition period, enabling the same taxonomy to be used at runtime with the appropriate rule set applied to each entity and ensuring semantic meaning is not disaggregated.

Table 3: Error/Warning Messages

Scenario	Message Type	System Message
Non-SBT	Warning	Ensure the CC and CE are related/not related to Asset Integrity
SBT and Non-SBT	Warning	CC and CE are related/not related to SBT. If related, input the Asset Integrity code
SBT	Error	CC and CE are related to Asset Integrity; the Asset Integrity code in "item text" is mandatory
SBT	Error	Asset Integrity code is not defined; please recheck the line
SBT	Error	Enter the SBT code for the multiple account assignment line

Upon a PR being saved or checked, the system will run a contextual validator that will check the assignment of the account in the line against the sustainability mapping catalogue. The design realizes graduated enforcement: advisory where ambiguity is anticipated (yellow warning when dealing with non-SBT contexts, Figure 4.9), conditional where usage is varied (yellow warning when dealing with mixed SBT/non-SBT contexts, Figure 4.10), and hard blocking where mapping is certain (red error when dealing with mandatory SBT contexts, Figure 4.11). The system will block errors during saving if SBT codes are undefined or invalid, and validation is not performed until valid codes are entered (Figure 4.12). After a blocking error, the system will not save until valid codes are entered (Figure 4.13). In several account assignments, the validator applies the same governance logic to every split to avoid biased or incomplete tagging (Figures 4.14-4.15). The taxonomy architecture integrates three key design concepts: proximity to intent (sustainability meaning captured at PR creation), semantic persistence (automatic inheritance into RFQ and PO enforced), and governed validity (taxonomy paired with a dictionary, validation logic, and enterprise-aware activation mechanisms).

4.3 Deployment Phase

The implementation period focused on detailed training and change management to ensure user success. The role-based learning paths were developed within the framework of the training program financial staff were trained on

tagging transactions and validation rules, CSR staff on accessing sustainability costs data in the Power BI dashboards, procurement staff on how to use sustainability codes when creating purchase requisitions, and IT support staff on how to configure and troubleshoot the system. The staff of the IT Department described the approach:

"We designed training that was hands-on and practical. Rather than lengthy presentations, we focused on real transaction examples and let users practice tagging in a sandbox environment. This helped build confidence before they worked with live data."

Training delivery will include classroom-based training, practical training in sandbox environments, and quick-reference materials for role-specific training. Training to approximately 85% of the intended users was completed before go-live, and other staff were trained during the hypercare period. Even so, difficulties arose in coordinating the timetable and maintaining a steady stream of messages. According to the noted training gaps by the Finance Department staff:

"The initial training was helpful, but we encountered situations in daily work that weren't covered in the standard curriculum. We needed follow-up training on specific scenarios and more examples of how to handle ambiguous cases."

Change management efforts complemented technical training. A communication campaign was used to demonstrate the strategic reasons why SBT can be implemented, focusing on the benefits that will accrue to various stakeholder groups rather than making SBT a compliance liability. An organization was formed of change champions and staff members of each of the major business units, who were honored and recruited as the local champions of change and informal support networks. The staff in the Sustainability Department commented:

"Technology implementation is easy compared to changing how people work. The change champions made a huge difference because they could explain the benefits in the local context and help colleagues see how SBT would actually make their jobs easier in the long run, not harder."

The opposition to change was expressed mainly through concerns about the extra workload and ambiguity in classification choices. The solution was to deliver real value by providing early, quick wins and demonstrating how the program managers would prove their success through better sustainability cost visibility.

The SBT system implementation was carried out under a six-month recovery plan between the pilot and full implementations. The initial step was a pilot trial involving a small number of business units, given relatively simple sustainability practices and local-level leadership backing. The members of the IT Department reported on the pilot approach:

"We deliberately chose pilot sites where we expected success. This wasn't about avoiding challenges but about building proof points that would convince skeptical users elsewhere. The pilot sites became our success stories that we could share during later rollout phases."

Pilot participants provided extensive feedback, prompting several modifications to the system configuration, especially regarding validation rule logic, which was found to be overly restrictive in practice. The way dashboards were designed changed based on pilots' preferences, and training materials were revised to reflect their actual experience. Following a successful pilot, deployment was rolled out to other business units in waves, depending on operational level and readiness assessment.

Each wave was launched according to a well-designed cutover plan, including final data verification, user access setup, and a war room with the implementation team and IT support, ready to provide urgent support during the critical initial days. General Manager staff noted:

"Having immediate support available during those first few days was critical. Users knew they could get help quickly if they ran into problems, which reduced anxiety and encouraged them to actually use the system rather than trying to work around it."

There was early production assistance during the hypercare phase, geared toward the urgent resolution of issues. The volume of tickets to the help desk is high in the first two weeks after each wave deployment, after which it reduces as users get acquainted. Testing of the system's performance showed no serious technical problems, indicating extensive testing during the pilot stage. Validation rules and dashboard refresh schedules were slightly adjusted based on user feedback. The Procurement Department staff reported the change:

"The first few weeks were definitely a learning curve. We had to think differently about how we coded purchases. But after a month or so, it became second nature. The key was having good support available when we needed it and not being afraid to ask questions."

By the end of the six-month rollout period, the SBT system was operational across all major business units with active sustainability programs. User adoption metrics showed steady improvement from initial deployment through the first quarter of full operation. The phased approach successfully managed implementation risk while building organizational capability and confidence.

4.4 Post-Implementation Phase

The Sustainability Budget Tagging implementation achieved significant gains in operational efficiency, ESG performance, technical system performance, and business intelligence capabilities. The post-implementation evaluation assessed performance against baseline parameters, and the results showed substantial improvements across all assessed dimensions. The time taken to prepare reports was reduced by one-third, from analysts' 10 working days to 7 working days. The accuracy of reporting increased to 95% from 85% due to standardized taxonomy and clear definitions, as well as automated validation rules. The number of budget allocation errors dropped from 20 major cases each year to 5, a 75% reduction. Transparency in reporting increased to seventy percent to ninety percent, indicating granular program-level reporting and systematic audit trails (Table 4). This was observed by Finance Department staff:

"What used to take us two full weeks of intensive work now takes one week. The system is doing automatically what we used to do manually, like aggregating costs by sustainability category and validating that transactions are properly tagged."

Table 4: Operational Efficiency Improvements

Indicator	**Before SBT**	**After SBT**	**Change**
Report Preparation Time (days)	10	7	-30%
Reporting Accuracy	85%	95%	+10%
Budget Allocation Errors (per year)	20	5	-75%
Reporting Transparency	70%	90%	+20%

The compliance rates for environmental regulation increased to 95% from 80%, and for social regulation to 85% from 75%; the timeliness of ESG reporting increased to 90% from 60%. The sustainability projects attained 80% instead of 65% of the achievement, indicating improved program management through real-time cost visibility (Table 5). Seniorize and Regulatory Affairs staff wrote:

"The ESG rating agencies definitely noticed the improvement in our disclosure quality. We went from providing aggregate estimates to giving them detailed program-level data with clear audit trails. That transparency alone improved our scores."

Table 5: ESG and Compliance Performance Improvements

Indicator	Before SBT	After SBT	Change
Environmental Regulation Compliance (%)	80%	95%	+15%
Social Regulation Compliance (%)	75%	85%	+10%
Timeliness of ESG Reporting (%)	60%	90%	+50%
Achievement of Sustainability Initiatives (%)	65%	80%	+15%

There was a significant improvement in the performance of the technical systems across all the ERP modules. The effectiveness of the Material Management module had increased by seventy percent to ninety-five percent, the Controlling module by eighty percent to ninety-six percent, Financial Accounting by eighty-five percent to a hundred percent, and integration efficiency between modules by seventy-five percent to ninety percent. The level of user satisfaction with the ERP modules increased to 85% from 65% (Table 6). IT Department personnel are characterized:

"Before SBT, sustainability tracking happened in parallel to normal ERP processes. Now it's embedded in the standard workflows. The sustainability codes flow automatically through the system just like any other financial dimension."

Table 6: ERP Module Effectiveness Improvements

ERP Module	Effectiveness Indicator	Before SBT	After SBT	Change
Material Management (MM)	Efficiency in Material Management	70%	95%	+25%
Controlling (CO)	Cost Control of Projects	80%	96%	+16%
Financial (FI)	Accuracy in Transaction Recording	85%	100%	+15%
Integration	Integration Between Modules	75%	90%	+15%
User Experience	User Satisfaction with ERP Modules	65%	85%	+20%

The implementation of the Power BI dashboard made a great contribution to the business intelligence. The real-time budget monitoring feature increased from fifty percent to eighty-five percent, the speed of decision making from sixty percent to seventy-five percent, the accuracy of information from seventy percent to ninety percent, user satisfaction increased from sixty-five percent to eighty-five percent, and the frequency of using the dashboard increased from forty percent to eighty percent (Table 7). General Manager personnel narrated:

"Before, if the Board asked about sustainability spending, we'd need days to compile answers. Now I can pull up the dashboard during meetings and show them exactly where we are against budget, which programs are on track, and where we might need adjustments."

Table 7: Power BI Dashboard Impact on Decision-Making

Indicator	Before Power BI	After Power BI	Change
Real-Time Budget Monitoring Capability (%)	50%	85%	+35%
Decision-Making Speed (%)	60%	75%	+15%
Accuracy of Information Used in Decisions (%)	70%	90%	+20%
User Satisfaction with Dashboards (%)	65%	85%	+20%
Frequency of Dashboard Usage in Decision Processes (%)	40%	80%	+40%

Although there were considerable gains, the implementation faced major challenges. System integration issues were experienced in 40% of implementation tasks, system customization issues accounted for 35% of technical effort, and data consistency issues occurred in 25% of deployment activities. The biggest impact challenge was identified as inadequate user training, as revealed by 50% of user feedback in the first six months after deployment. Resistance to change was present in 30% of business units, and coordination issues in departments were experienced in 20% of activities (Table 9). IT Department staff explained:

"We underestimated how much effort would be required to ensure the sustainability codes maintained integrity as transactions flowed through different modules. What seemed straightforward in design became complex in implementation when we encountered all the edge cases and exception scenarios in real business processes."

Table 8: Implementation Challenges and Impact

Challenge Type	Description	Frequency	Impact
Technical Challenges			
System Integration	Difficulties integrating SBT with existing ERP modules	40%	High
System Customization	Requirement for significant customization	35%	Medium
Data Consistency	Maintaining data consistency across modules	25%	Medium
Non-Technical Challenges			
User Training	Insufficient training for effective use	50%	High
Resistance to Change	Employee resistance to changes in workflows	30%	Medium
Department Coordination	Coordination between departments	20%	Low

Post-implementation stakeholder views were evaluated using qualitative interviews and quantitative surveys. Stakeholders in the finance sector stressed the need to transition from manual operations to ensure the smooth flow of work. The CSR stakeholders emphasized improved credibility with external stakeholders. The IT stakeholders reported lower load on ad hoc data extraction requests. The top management appreciated the ability to make strategic decisions. The compliance stakeholders pointed to the responsiveness of the regulation. The qualitative results were supported by quantitative survey results across five areas, including: ERP system functionality (3.65 out of 5.00), 5P sustainability dimensions (3.85), technical and organizational challenges (4.05), sustainability outcomes (3.80), and future improvement priorities (4.55; Table 10).

Table 9: Stakeholder Satisfaction Survey Results

Category	Assessment Dimension	Mean Score
ERP System with SBT (3.65)	Ease of use	4.00
	System integration	4.00
	Meeting management needs	3.75
	Data reliability	3.25
	Power BI effectiveness	3.25
5P Dimensions (3.85)	People (employee welfare)	4.00
	Planet (environmental tracking)	3.50
	Prosperity (economic goals)	4.25
	Peace (social stability)	3.75
	Partnership (collaboration)	3.75
Technical & Organizational Challenges (4.05)	ERP customization difficulty	4.75
	Data consistency issues	3.75
	Training effectiveness	3.75
	Team adaptation	3.75
	Regulatory alignment challenge	4.25
Sustainability Outcomes (3.80)	Budget transparency	4.00
	Accountability enhancement	4.00
	ESG compliance support	4.00
	Stakeholder satisfaction	3.50
	Strategic decision support	3.50
Future Improvement Priorities (4.55)	Further customization value	4.50
	Ongoing training necessity	5.00
	Collaboration features benefit	4.25
	Comprehensive dashboards value	4.75
	Feedback mechanisms likelihood	4.25

5. Discussion

This study addresses a critical gap in empirical research on Sustainable ERP systems by demonstrating specific mechanisms for operationalizing sustainability in ERP architectures within emerging-economy state-owned enterprises. What makes the Sustainability Budget Tagging system at PT Pertamina particularly noteworthy is its demonstration that systematic sustainability cost monitoring can be achieved by configuring existing ERP systems rather than installing parallel systems or implementing complete system replacements. For organizations with existing ERP investments seeking to enhance their sustainability management capabilities without incurring prohibitive costs, this finding offers significant practical implications (Chofreh et al., 2020; Muller et al., 2020).

The performance improvements observed across multiple dimensions were substantial. Operational efficiency gains included a 30% reduction in reporting preparation time, while ESG compliance strengthened with a 21% increase in scores. Business intelligence capabilities saw a 35 percentage point increase in real-time monitoring. These results confirm theoretical predictions in Environmental Management Accounting that systematic cost tracking facilitates enhanced accountability and superior decision-making (Burritt et al., 2002; Jasch, 2003; Schaltegger & Burritt, 2018). Perhaps most striking were the 75% reduction in budget allocation errors and the 40 percentage-point increase in dashboard usage, suggesting that ERP-integrated sustainability tracking generates value that extends well beyond compliance reporting, fundamentally transforming core sustainability program management practices. The multidimensional accountability framework of Stakeholder Theory is strongly validated here, as enhanced transparency demonstrably strengthened relationships with diverse stakeholder groups, including regulators, investors, and ESG rating agencies (Freeman, 1984; Mitchell et al., 1997; Clarkson, 1995).

Implementation was not without its challenges. System integration problems emerged in 40% of activities, while insufficient user training affected 50% of users. These challenges align with the broader ERP implementation literature, which emphasizes the dual technological and organizational change processes required for successful deployment (Luo & Strong, 2004; Shaul & Tauber, 2013; Grabski et al., 2011). Particularly telling was the difficulty finance personnel had with sustainability classification decisions, which revealed confusion when encountering unfamiliar scenarios. This suggests that sustainability-tracking implementations require greater domain knowledge than traditional financial system implementations. The Technology Acceptance Model's predictions extend here, as perceived ease of use encompasses not only interface design and technical training but also users' conceptual understanding of sustainability frameworks and their organizational application (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Comprehensive training programs that develop both technical proficiency and sustainability literacy thus become essential organizational investments.

A key architectural insight emerged from the decision to capture sustainability semantics at the Purchase Requisition level rather than during financial close (Davenport, 1998; Strong & Volkoff, 2010). This "proximity to intent" principle ensures that sustainability meaning is captured when business needs are defined by personnel with contextual knowledge, rather than being reconstructed retrospectively by finance analysts lacking program-level understanding. The system's graduated enforcement mechanism—advisory warnings for ambiguous contexts, conditional prompts for mixed classifications, and hard blocking for definitive sustainability expenditures—represents nuanced governance that balances data quality objectives against operational flexibility (Petter et al., 2013). Such design patterns effectively resolve inherent ERP implementation tensions between standardization and customization by introducing flexibility within structured validation logic (Pollock & Cornford, 2004).

Strategic choices in the implementation approach also proved consequential. The phased rollout strategy deliberately selected pilot locations with high success probability, reflecting practical application of change management theory to sustainability contexts where stakeholder skepticism demands concrete evidence before broader acceptance (Kotter, 1996; Armenakis & Harris, 2009). Dashboard usage patterns tell an interesting story: the increase from 40% to 80% validates Resource-Based View predictions that IT capabilities generate the greatest value when combined with complementary organizational capabilities such as data-driven decision-making and analytical skills (Bharadwaj, 2000; Wade & Hulland, 2004; Piccoli & Ives, 2005).

The state-owned enterprise context introduces unique dynamics worth careful consideration. PT Pertamina's government ownership provided powerful institutional incentives for transparency investments—incentives that may be weaker in private-sector contexts where sustainability monitoring potentially conflicts with short-term profitability objectives (Bruton et al., 2015; Musacchio et al., 2015). Indonesia's dynamic ESG regulatory landscape further shaped implementation, with mandatory disclosure standards effective January 2027, creating both urgency and complexity. Regulatory timelines established clear implementation imperatives, while regulatory uncertainty influenced taxonomy design decisions (Chapple & Moon, 2005; Amran & Haniffa, 2011).

Several limitations warrant acknowledgment. The single-case design, while enabling deep contextual insights, limits direct generalizability to organizations differing substantially in size, sector, or institutional context (Yin, 2018). Nevertheless, analytical generalization to theoretical propositions remains robust. These findings validate and extend Environmental Management Accounting theories by confirming that systematic cost tracking improves decision-making. They refine the Technology Acceptance Model assumptions by identifying sustainability-specific adoption factors. They also strengthen Stakeholder Theory principles by demonstrating how transparency enhancements improve stakeholder relationships. Future research examining the implementation of sustainability budget tagging across diverse organizational contexts would help identify patterns of consistency and contingency factors. The mixed-methods triangulation employed here—integrating qualitative and quantitative analyses—strengthens inference confidence, with stakeholder interview themes corroborating quantitative metrics and providing consistent explanations across methods, data sources, and time periods.

6. Conclusion

This study has investigated the case of Sustainability Budget Tagging implementation in the SAP ERP system at PT Pertamina, highlighting key gaps in current knowledge of how organizations operationalize sustainability cost tracking within their enterprise information architecture. The single-case study conducted a holistic study with a before-and-after comparison, reporting significant performance improvements that demonstrated that systematic sustainability cost monitoring could be achieved by configuring existing ERP infrastructure rather than using parallel systems.

The implementation generated measurable value: a 30% reduction in reporting preparation time, a 75% reduction in budget allocation errors, a 50% improvement in reporting timeliness, and a total annual financial impact of $919,000, with payback within 2 years. Technical system performance improved substantially across Material Management (25 percentage points), Controlling (16 percentage points), and Financial Accounting (15 percentage points) modules. Business intelligence capabilities improved dramatically, with dashboard usage frequency increasing from 40% to 80%.

The theoretical contributions of the study fill gaps in the literature on Sustainable ERP by offering detailed empirical data on mechanisms that enable sustainability within the ERP architecture (Jaradat et al., 2025; Yurtay, 2025). The results confirm theoretical predictions of Environmental Management Accounting and reflect the patterns of implementation design of greater applicability. The architectural principles of proximity to intent and graduated enforcement mechanisms are transferable strategies that address inherent conflicts between standardization and customization in ERP settings. The study also helps to understand the implementation of S-ERP in poorly researched settings: state-owned firms in emerging markets operating in the energy sector.

The following are some of the practical implications: The sustainability budget tagging could be achieved by configuring existing SAP infrastructure without necessarily replacing the system, multi-faceted value frameworks should consider strategic benefits other than operational efficiency gains, phases of rollout plans focusing on high-probability sites of success are especially useful in sustainability, the configuration of ongoing training investments are still relevant to both technical and conceptual insight, and change management strategies that rely on local champions are especially constructive in sustainability. In a single-case design, there is no direct statistical generalization, but analytical generalization to theoretical propositions is strong. Future studies are encouraged to consider organizational implementations across several organizations to examine contingency factors, follow up on the long-term sustainability of the improvements, seek further integration with physical sustainability

performance indicators, study the situation in the private sector, and examine sectoral variance in other areas beyond energy.

Despite limitations, the research is insightful, providing empirical evidence that addresses an important gap in the Sustainable ERP literature and has potential practical implications for organizations seeking to improve sustainability cost-tracking capabilities. With increased regulatory pressure on sustainability reporting worldwide and heightened expectations from various stakeholders for ESG reporting, systematic methods for tracking sustainability costs will be of greater significance for organizational legitimacy and strategic decision-making.

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Data Availability Statement: The data supporting this study are derived from confidential interviews with PT Pertamina personnel and internal organizational documents. Due to confidentiality agreements and commercially sensitive information, raw interview data and detailed system configuration specifications cannot be publicly available. Anonymized analytical data and aggregated performance metrics are available from the author upon reasonable request.

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Green Banking Disclosures and Financial Performance of Indonesian Listed Banks: A Comparative Study Across Bank Size Categories

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Abstract
Indonesian banking regulations divide commercial banks into BUKU 1, 2, 3, and 4 categories based on core capital, and through POJK 2017 regulate the obligation to implement sustainable finance and different deadlines for preparing Sustainability Reports (SR) for BUKU 3–4 and BUKU 1–2 banks. Further strengthening comes through SEOJK 2021, which regulates the form and content of annual reports and sustainability reports in more detail. Starting from this context, this study examines the extent of green banking disclosures (GBD) of Indonesian listed banks over the period 2019–2023. Specifically this study aims to : (1) examine the GBD trends of listed banks in Indonesia for the above period; (2) examine whether there are differences in GBD levels between BUKU 1, 2, 3, and 4 bank categories; (3) examine whether there are differences in GBD levels before and after the issuance of SEOJK 16/2021; and (4) testing whether there are differences in financial performance between BUKU 1, 2, 3, and 4 banks. GBD is measured using an index adapted from Bose (2018) through content analysis of annual reports and sustainability reports, while financial performance is proxied by ROA, CAR, NPL, and LDR. The results show that GBD exhibits a gradually increasing trend, with BUKU 4 banks consistently achieving the highest mean disclosure level each year. The extent of GBD improves significantly following the 2021 regulation, indicating a positive regulatory effect on disclosure practices. ANOVA tests confirm that GBD levels differ statistically across the four bank categories and follow a clear size-related pattern: BUKU 1 has the lowest disclosure, rising sequentially up to BUKU 4 as the highest. Similarly, significant differences are observed in ROA, CAR, NPL, and LDR across BUKU groups: BUKU 4 records the highest ROA and the lowest NPL, while BUKU 2 shows the highest CAR and LDR. Overall, the findings suggest that regulatory tightening and bank size jointly shape the landscape of GBD in Indonesian listed banks, reflecting the interaction between sustainability and prudential performance dimensions in the Indonesian banking landscape. This finding implies that regulation and resource capacity (bank size) jointly drive GBD levels. Therefore, the Financial Services Authority (OJK) needs to provide more targeted support and capacity building for small banks, while bank management needs to allocate adequate resources for green reporting systems to remain legitimate and competitive in the market.

Keywords: Green Banking, Sustainable Finance, Green Banking Disclosure, Sustainable Finance Disclosure, Financial Performance, Bank Size (BUKU)

1. Introduction

Climate change and environmental degradation have transformed the way financial institutions are expected to conduct their business. Banks, which were traditionally viewed as "non-polluting" sectors, are now recognized as pivotal intermediaries that can accelerate or hinder the transition to a low-carbon economy through their lending, investment, and risk management activities (Mir & Bhat, 2022; Park & Kim, 2020). In many jurisdictions, regulators and stakeholders increasingly demand that banks embed environmental, social, and governance (ESG) considerations into their strategies and disclose, in a transparent manner, how they manage climate and environment-related risks and opportunities (Manta et al., 2025). Green banking disclosure (GBD) has thus become a crucial aspect of company reporting, serving as both a communication instrument and a means of accountability and reducing information asymmetry (Gunawan et al., 2022).

As part of the country's commitment to the Paris Agreement to reduce carbon emissions and the Sustainable Development Goals, Indonesia has released a comprehensive sustainable finance framework (OJK, 2014). The cornerstone is the Financial Services Authority (Otoritas Jasa Keuangan/OJK) Regulation No. 51/POJK.03/2017 on the Implementation of Sustainable Finance for Financial Services Institutions, Issuers, and Public Companies. This regulation mandates financial institutions, including banks, to apply sustainable finance principles, submit a Sustainable Finance Action Plan (Rencana Aksi Keuangan Berkelanjutan/RAKB), and prepare a Sustainability Report either as an independent document or integrated within the annual report (OJK, 2017). In parallel with this overarching regulation, OJK issued Circular Letter No. 16/SEOJK.04/2021 on the Form and Content of Annual Reports of Issuers or Public Companies, which provides detailed guidance on the minimum content of annual reports, including sections on corporate governance and social and environmental responsibility, and aligns disclosure practices with the ASEAN Corporate Governance Scorecard (OJK, 2021a). Together, POJK 51/2017 and SEOJK 16/2021 strengthen the regulatory basis for sustainability-related disclosure in Indonesian listed banks.

Within this regulatory context, green banking disclosure can be defined as the extent to which banks report their policies, practices, products, and performance that contribute to environmental protection and sustainable development, including the management of environmental risks in lending, the provision of green products, internal eco-efficiency initiatives, and the governance mechanisms overseeing these activities (Firmansyah & Kartiko, 2024; Setyowati, 2023). GBD is expected to help stakeholders assess whether banks are effectively integrating sustainable finance principles into their operations, and to evaluate the credibility of their green commitments (Ahmar et al., 2024; Bukhari et al., 2020). At the same time, disclosure is not merely a neutral reflection of practice; it can also be used strategically to gain legitimacy, signal superior governance and risk management, or respond to coercive and normative pressures from regulators, investors, and civil society (Aslam & Jawaid, 2023; Bose et al., 2018). In emerging markets such as Indonesia, where information asymmetries and enforcement challenges remain significant, the quality and consistency of GBD become even more critical for influencing market perceptions and regulatory trust (Miah et al., 2021; Setyowati, 2023; Silalahi et al., 2023).

The structure of the Indonesian banking industry provides an additional institutional feature that is highly relevant to GBD. Historically, banks have been categorized into four "BUKU" (Kelompok Bank Umum berdasarkan Kegiatan Usaha) groups based on their core capital: BUKU 1 banks with core capital below IDR 1 trillion, BUKU 2 with IDR 1–<5 trillion, BUKU 3 with IDR 5–<30 trillion, and BUKU 4 with at least IDR 30 trillion and the broadest permissible business activities, including overseas operations (BI, 2012). More recently, OJK has transitioned to a new Core Capital Based Bank Group (Kelompok Bank berdasarkan Modal Inti/KBMI) classification, but the underlying logic remains similar: core capital serves as a proxy for bank size, operational scope, and capacity to absorb risks (OJK, 2021b). Larger banks (BUKU 3 and 4 or KBMI 3 and 4) usually have more resources, more complex governance structures, and a higher risk of reputational damage (OJK, 2024). This may mean that they have stronger incentives and abilities to provide extensive GBD than smaller banks. However, smaller banks may also face increasing regulatory pressure to comply, even when their internal systems and human resources are less developed. As an example, in the application of sustainability reporting, according to OJK (2017), for Bank BUKU 3 and BUKU 4, the obligation to implement sustainable finance and prepare an SR starts on 1 January 2019. Meanwhile, for Bank BUKU 1 and BUKU 2, the obligation to implement sustainable finance and prepare an SR comes later, starting on 1 January 2020.

A growing body of literature has begun to examine the determinants and consequences of green banking disclosure in both developed and emerging markets. Bose et al. (2018), focusing on Bangladeshi banks, found that regulatory guidance and corporate governance mechanisms positively influence GBD, and that disclosure practices tend to converge over time as green banking becomes routinized. In the context of the United States (US) bank, Hu and Borjigin, (2025) investigate whether the quality of climate risk disclosure influences banks' contributions to systemic risk. The study found that banks with higher-quality climate disclosures experience lower information asymmetry, reduced stock price volatility and downside market risk, and a smaller likelihood of transmitting systemic risk. In other words, more transparent and specific climate disclosures help strengthen overall financial stability and market resilience. In Indonesia, several studies have used the GBD index to investigate how corporate governance (Rahayu & Djuminah, 2022; Yulia et al., 2025), ownership structure (Kartiko & Firmansyah, 2024; Karyani & Obrien, 2020), and financial performance (Citraningtyas et al., 2024) relate to green banking disclosure in listed banks. These studies generally support the view that institutional pressures, board characteristics, and capital strength can shape the extent of GBD. In addition, a recent systematic review highlights that GBD has evolved into a growing research area since 2008, with increasing attention to measurement indices and institutional determinants, yet also notes that the evidence is fragmented across countries and time periods (Akomea-Frimpong et al., 2022).

Other studies observe a comparative analysis of bank disclosures. The analysis includes green banking practices and reporting and corporate social responsibility (CSR) disclosure comparisons between conventional and Islamic banks or between the two countries. Rahman et al. (2023) compare the green practices and reporting among banks in India and Bangladesh. The results reveal that compared to the Bangladesh Bank, Indian banks have expanded their green initiatives and invested more in green projects. Simsek et al. (2024) investigated the climate-related disclosure (CRD) differences between Islamic and conventional banks in a global context. The study finds that conventional banks share more information about climate change than Islamic banks, as Islamic banks are more focused on sharia compliance, which doesn't put much stress on protecting the environment. In other words, commercial banks may be more attentive to the needs of shareholders and stakeholders regarding climate and environmental issues. The effects were more pronounced with governance quality; conventional banks publish greater amounts of CRD information as governance quality improves, whereas Islamic banks disclose even less as their governance quality increases. In Indonesia, a study finds that Islamic banks provide more information about their CSR activities than conventional banks (Hamdani et al., 2020). The shortfalls in CSR disclosure for Sharia banks pertained to environmental and general information aspects, whereas conventional banks exhibited weaknesses in energy, employee health and safety, product, and community engagement. In terms of comparison, the review in the extant literature suggests that there is a lack of literature comparing GBD across different sizes of banks.

Gunawan et al. (2022) explore GBD in Indonesia over a nine-year period (2009-2017). The study concludes that the sustainability reporting of the Indonesian banking sector remains unsatisfactory. They have yet to comprehend the significance of serving as mediators and their indirect influence on individuals, the environment, and profit. The study expects that the GBD of Indonesian banks is anticipated to increase over time due to the implementation of POJK Number 51, which became effective in 2018. In line with Gunawan et al.'s findings, this study identifies some gaps. First, there is still limited evidence on how GBD has developed in Indonesian listed banks over the period when POJK 51/2017 was already in force and SEOJK 16/2021 was subsequently introduced. While POJK 51/2017 established the overarching sustainable finance framework (OJK, 2017), SEOJK 16/2021 tightened and clarified reporting expectations, particularly regarding the form and content of annual and sustainability reports (OJK, 2021a). It is therefore relevant to ask whether this regulatory refinement is associated with observable changes in the level of GBD. Second, as stated previously, relatively few studies explicitly compare GBD across bank size categories, even though differences in core capital, business complexity, and market visibility suggest that disclosure behavior may vary systematically from BUKU 1 to BUKU 4. Third, while financial performance indicators such as return on assets (ROA), capital adequacy ratio (CAR), non-performing loans (NPL), and loan-to-deposit ratio (LDR) are frequently used as explanatory or outcome variables in green banking studies, there is scant description of how these performance profiles differ across bank size groups in the context of the evolving sustainable finance regime in Indonesia.

Given the unique regulatory environment of the Indonesian banking industry discussed earlier, this study seeks to fill existing gaps by conducting a comparative analysis of green banking disclosure (GBD) and financial performance among Indonesian listed banks from 2019 to 2023. The research questions are presented as follows.
RQ 1: What is the level and trend of green banking disclosure among Indonesian listed banks during 2019–2023?
RQ2: Did the issuance of SEOJK 16/2021 impact the level of GBD, particularly in the comparison of the periods preceding and succeeding the regulation?
RQ3: Do banks of different sizes, as defined by the BUKU groups (1–4), have different levels of GBD?
RQ4: Are there any differences in financial performance, proxied by ROA, CAR, NPL, and LDR, across these bank size categories?

To answer these questions, the study uses an archival method, which means it looks at annual and sustainability reports to arrive at the GBD index score for each bank-year observation. Banks are categorized into BUKU 1, 2, 3, and 4 based on their core capital. Descriptive and inferential statistics, including ANOVA, are utilized to analyze variations in disclosure and performance among groups and periods. The study doesn't look at the statistical link between GBD and financial performance; instead, instead, it focuses on describing and comparing the patterns of disclosure and performance across bank size categories and regulatory phases.

This research enhances existing literature in several ways. Theoretically, it expands institutional and legitimacy frameworks by demonstrating how a specific regulatory measure, SEOJK 16/2021, aligns with changes in disclosure practices within an emerging market banking system. Additionally, it presents multi-year studies of green banking reporting in Indonesian listed banks from 2019 to 2023, utilizing an index to illustrate both trends over time and differences across size categories. Practically, the research offers insightful information to regulators, bank management, and investors regarding the responses of various segments of the banking sector to sustainability reporting requirements. The study identifies areas that require additional guidance or capacity-building initiatives, especially for smaller institutions.

This study is grounded in three interrelated theoretical perspectives: legitimacy theory, institutional theory, and resource-based view (RBV) theory. Legitimacy theory asserts that companies strive to align their operations with societal values and expectations (Dowling & Pfeffer, 1975). Banks are more likely to expand their GBD when social norms about environmental responsibility and sustainability become stricter, as indicated by national regulations, for example, POJK 51/2017 and SEOJK 16/2021. The disclosure of sustainable finance makes a bank keep or regain legitimacy (Deegan, 2002). In this perspective, an increase in GBD over time and greater transparency post-2021 align with banks' efforts to establish and uphold legitimacy with regulators, the public, and international stakeholders.

Institutional theory, specifically the idea of coercive isomorphism, shows how formal rules and expectations from supervisory agencies affect how organizations act (DiMaggio & Powelll, 1983). POJK 51/2017 and SEOJK 16/2021 are examples of coercive pressures that force banks to use sustainable finance practices and share important information in a specific format. From an institutional point of view, the rise in GBD after 2021 would suggest that the regulatory environment is good at getting people to change their behavior. On the other hand, the fact that there are still differences between BUKU categories would suggest that organizational resources and power affect how these pressures affect people.

From a RBV perspective, the disclosure of green banking can be regarded as a consequence of a bank's internal resource endowments. Companies with well-organized resources are more likely to be able to create advanced reporting systems and sustainable business practices (Barney, 1991; Wernerfelt, 1984). Hence, the theory suggests that larger banks (BUKU 4) possess superior slack resources, financial, technological, and human capital, which enable them to implement sophisticated green reporting systems that smaller banks (BUKU 1) cannot afford.

Previous studies indicate that following the issuance of regulations on CSR disclosure guidelines, the extent of CSR disclosures by listed companies in Indonesia increased (Ika et al., 2017), and a similar trend was observed in Malaysia (Esa & Ghazali, 2012). Additionally, Bose et al. (2018) present a foundational empirical study showing

that regulatory guidance and corporate governance characteristics significantly influence the level of GBD in Bangladeshi banks, with disclosure practices becoming more homogeneous over time. Based on the regulatory timeline, we argue that the technical clarity provided by SEOJK 2021 reduces information asymmetry and encourages higher compliance. Therefore, this study hypothesizes that there will be an increasing trend in GBD from 2019 to 2023 (H1) and that there will be a significant difference in GBD levels before (2019-2020) and after (2022-2023) the implementation of SEOJK 2021 (H2).

Drawing from RBV, larger banks have better access to resources and face greater scrutiny from international investors. Hence, this study posits that there is a significant difference in GBD levels among bank categories (BUKU 1, 2, 3, and 4), where larger banks exhibit higher disclosure (H3), and there are significant differences in financial performance (ROA, CAR, NPL, LDR) among bank categories (BUKU 1, 2, 3, and 4) (H4).

2. Method

2.1 Sampling and Data

The population includes conventional commercial banks listed on the Indonesia Stock Exchange (IDX). Through purposive sampling, the final sample is made up of banks that published consecutive annual or sustainability reports from 2019 to 2023. As of December 31, 2023, a total of forty-seven commercial banks on the IDX had published sustainability reports. The samples were selected based on the availability of both annual and sustainability reports throughout the consecutive observation period from 2019 to 2023. Four banks were found to have incomplete annual and sustainability reports. As a result, the final sample consists of 43 banks, leading to a total of 215 bank observations.

The 43 banks are categorized into four groups based on the BUKU size classification, which is determined by equity capital. The capital thresholds are defined as follows: BUKU 1 banks have core capital below IDR 1 trillion; BUKU 2 banks have core capital ranging from IDR 1 trillion to less than IDR 5 trillion; BUKU 3 banks have core capital between IDR 5 trillion and less than IDR 30 trillion; and BUKU 4 banks have at least IDR 30 trillion, allowing for a broader range of permissible activities, including international operations. Although there has been a transition to the KBMI (Core Capital-Based Bank Group) classification in recent regulations, the mapping between the BUKU and KBMI classifications remains closely aligned: smaller BUKU banks correspond broadly to KBMI 1, while larger BUKU banks align with higher KBMI categories (OJK, 2021b). In total, there are four banks classified as BUKU 4, namely Bank Central Asia, Bank Negara Indonesia, Bank Rakyat Indonesia, and Bank Mandiri. Additionally, nineteen banks are classified as BUKU 1, nine banks fall into the BUKU 2 category, and eleven banks are classified as BUKU 3. A detailed list is provided in the appendix. Although the OJK transitioned to the KBMI classification in 2021, the BUKU classification has been retained for the sake of longitudinal consistency.

2.2 Measurement of Green banking Disclosures

Consistent with previous research (Citraningtyas et al., 2024; Kartiko & Firmansyah, 2024; Khan et al., 2021) GBD is measured using an index. The disclosure index is constructed by synthesizing the framework of Bose et al. (2018). The index consists of 23 items across four dimensions: (1) Green Policy & Strategy, (2) Green Lending & Investment (including Green Bond/Sukuk), (3) Green Operations, and (4) Green Awareness/CSR. The scoring is dichotomous (1 if disclosed, 0 otherwise). The formula is:

$$GBD_a = \frac{\sum item\ that\ revealed}{21} \text{ x } 100 \quad (1)$$

2.3 Bank Financial Performance

This study utilizes four financial ratios as proxies for bank financial viability. The ratios are ROA, CAR, LDR, and NPL. Return on Assets (ROA) is a ratio that indicates how efficiently a bank generates profits from all assets

under its management. It is generally calculated by dividing profit (before or after tax, depending on the definition used) by total assets. For banks, ROA is an important indicator of management health and performance, as it reflects the bank's ability to efficiently manage third-party funds, disburse loans, manage securities, and other productive assets. The higher the ROA, the better the bank's ability to generate profits from its assets, making the bank more efficient and more attractive to regulators, investors, and other stakeholders (Munteanu & Ilie, 2021).

The capital-to-risk-weighted-assets ratio (CAR) is a numerical measure of a bank's financial strength. The Capital Adequacy Ratio (CAR) is a measure of a bank's ability to cover its earning assets' risks, particularly those associated with loans (Gharaibeh, 2023). This number is used to measure the strength of capital (Ika et al., 2023). According to Raharjo et al. (2014), banks must set aside a percentage of their total earning assets as capital. According to the Indonesian Central Bank (2013) regulation, all commercial banks in Indonesia are required to maintain a minimum capitalization of 8% of their risk-weighted assets. Banking institutions frequently maintain capital ratios over what is legally required in order to improve their lending operations. It will be able to maintain larger capital ratios at almost no cost due to the interest rate differential between deposits and loans (Islam, 2014). In this analysis, the LDR is the key indicator of a bank's liquidity. According to Ika et al. (2023)., determining the LDR involves dividing the total loan amount by the total deposit amount. Deposits into a conventional bank are defined as loans within this structure. This research suggests that a bank that has a low loan-to-deposit ratio (LDR) likely has more liquid assets than liabilities, which means it may have smaller profits and is thus more secure than a bank with a larger LDR. But an LDR shows that the bank's financial situation has worsened due to over-lending. That the bank could have to liquidate some loans at a loss to pay out depositors is another possible outcome. According to Islam (2014), a relatively high LDR number indicates that liquidity is tight.

The NPL is the number of loans that are not being paid back compared to the total number of loans. Some people call the banking industry a high-risk industry because of the way each bank does business. Banks usually function as middlemen, therefore their main concern is credit risk. The NPL ratio is a tool to measure credit risk. Thus, as NPL rises, the risk level for a bank also rises (Islam, 2014). Table 1 shows the measurement of variables that previously discussed.

2.4 Data Analysis

To test whether there is a change in GBD in pre and post SEOJK 16/2021 paired t test or Wilcoxon signed rank test is utilized depending upon the normality of the data. Meanwhile, ANOVA is employed to examine differences in disclosure and performance across groups and periods. Before we conduct the test of the differences, descriptive statistics are assessed to identify the pattern and trend of GBD and financial performance over the observation period.

Table 1: Proxies of Variables

No	Variable	Measurement	Source
1	Green Banking Disclosures (GBD)	$GBD_a = \frac{\sum item\ that\ revealed}{21}$	(Bose et al., 2018)
2	Return on Asset (ROA)	$ROA = \frac{Net\ Income}{Total\ Assets}$	(Munteanu & Ilie, 2021)
2	Capital Adequacy Ratio (CAR)	$CAR = \frac{Total\ Equity}{Assets\ weighted\ by\ risk}$	(Islam, 2014) (Gharaibeh, 2023)
3	Loan to Deposit Ratio (LDR)	$LDR = \frac{Total\ Loan}{Total\ Deposit}$	(Amidjaya & Widagdo, 2020)
4	Non-Performing Loan (NPL)	$NPL = \frac{The\ amount\ of\ non-performing\ loan}{Total\ loan\ given}$	(Caby et al., 2020)

3. Results and Discussions

3.1 Descriptive Statistics

Table 2 displays the descriptive statistics of all variables categorized by BUKU bank size. As presented in the table, the average GBD of all samples is 63 percent; the smallest GBD level is 5 percent, while the highest is 100 percent. Surprisingly, those who achieve 100 percent are not only in BUKU Bank 4, the highest-sized and premium bank, but also in BUKU Bank 2, the smaller level of banks. BUKU bank 1 achieves the lowest GBD at 5 percent, while its average GBD is 51 percent. The GBD in BUKU banks 2, 3, and 4 is 67 percent, 70 percent, and 90 percent, respectively, on average. It appears that the higher the size classification of the bank, the higher the GBD. The minimum level of GBD in BUKU banks 2, 3, and 4 is 14 percent, 43 percent, and 67 percent, respectively. It also follows the order of the bank size. The maximum level of GBD in BUKU bank sizes 1 and 3 is similar, i.e., 90 percent, while the maximum level in BUKU bank sizes 2 and 4 is the same, 100 percent.

Table 2: Descriptive Statistics of All Variables Categorized by BUKU Bank size

Variables	BUKU Bank categorization	N	Mean	Std. Dev.	Minimum	Maximum
GBD	1	95	0.51	0.22	0.05	0.90
	2	45	0.67	0.23	0.14	1.00
	3	55	0.70	0.14	0.43	0.90
	4	20	0.90	0.07	0.67	1.00
	Total	215	0.63	0.23	0.05	1.00
ROA	1	95	-0.29	2.78	-14.75	4.31
	2	45	0.87	5.05	-15.89	13.58
	3	55	1.70	0.83	0.09	4.22
	4	20	2.88	0.95	0.54	4.03
	Total	215	0.76	3.17	-15.89	13.58
CAR	1	95	35.83	21.46	9.01	127.42
	2	45	41.47	32.99	10.78	169.92
	3	55	24.33	4.84	17.31	38.70
	4	20	22.08	3.06	16.80	29.40
	Total	215	32.79	21.95	9.01	169.92
LDR	1	95	80.75	24.18	12.35	146.77
	2	45	95.07	32.77	40.94	163.19
	3	55	89.59	20.32	60.04	171.28
	4	20	80.79	8.95	61.96	96.37
	Total	215	86.01	24.99	12.35	171.28
NPL	1	95	1.88	1.40	0.00	4.96
	2	45	1.55	1.56	0.00	4.95
	3	55	1.11	0.73	0.20	3.15
	4	20	1.03	0.61	0.26	2.20
	Total	215	1.54	1.29	0.00	4.96

Source: Authors' compilation

In terms of ROA, the average profitability of the sample bank is relatively high at 0.76, while the minimum and maximum values of ROA are -15.89 and 13.58, respectively. This indicates that one bank has a loss 15.89 times higher than its assets, while another bank is profiting 13.58 times greater than its assets. Banks classified as BUKU size 2 recorded the lowest ROA, which is -15.89 percent. The average ROA values for BUKU bank sizes 1, 2, 3, and 4 are -0.29, 0.87, 1.70, and 2.88, respectively. This trend shows that profitability increases with the size of the banks' classification, indicating that larger banks tend to be more profitable.

The mean score for CAR is 32.79, with the lowest and highest scores being 9.01 and 169.92, respectively. The lowest score of CAR meets the minimum requirement of CAR set by the Indonesian Central Bank, which is 8.

The highest CAR is achieved by a bank in BUKU bank size 2, while the lowest CAR is obtained by a bank in BUKU bank size 1. The average CAR for BUKU banks 4 and 3 is 22.08 and 24.33, respectively, while the average CAR for BUKU banks 1 and 2 is 35.83 and 41.47, respectively. It appears that banks in BUKU bank sizes 1 and 2 have a higher CAR value than those in BUKU bank sizes 3 and 4; in other words, smaller banks have higher CAR.

The average value of LDR is 86.01, with the minimum and maximum numbers being 12.35 and 171.28, respectively. The highest average value of LDR is achieved by banks in BUKU bank size 2, i.e., 95.07, while the lowest average is achieved by banks in BUKU bank size 1, i.e. 80.75. The number is almost identical to the average LDR value of BUKU bank size 4, which stands at 80.79. The average LDR for banks in BUKU bank size 3 is 89.59. The highest LDR of banks in BUKU bank sizes 1, 2, and 3 is above 100, i.e., 146.77, 163.19, and 171.28, respectively. The data indicate that these banks are capable of extending credit beyond the total deposits they gather from the community.

In terms of NPL, the mean score is 1.54, with the minimum score of 0 and the maximum score of 4.96. The lowest and highest scores of NPL come from banks in BUKU bank size 1. The average score of NPL of BUKU bank size 1, 2, 3, 4 is 1.88; 1.55; 1.11; and 1.03 respectively. The number follows the order of bank size; the larger the bank, the smaller the NPL.

3.2 Trend of GBD

Table 3 displays the mean GBD scores for each year from 2019 to 2023, organized by BUKU bank size. This table illustrates the trend of GBD throughout the observation period for all samples and banks categorized by BUKU. Additionally, Figure 1 depicts the GBD trends of banks from 2019 to 2023, also categorized by BUKU bank size.

Table 3: Mean of GBD based on BUKU bank categorization

Bank Categorization	N	2019	2020	2022	2022	2023
BUKU 1	19	0.42	0.47	0.48	0.56	0.63
BUKU 2	9	0.57	0.57	0.64	0.76	0.79
BUKU 3	11	0.62	0.64	0.71	0.76	0.77
BUKU 4	4	0.83	0.91	0.91	0.93	0.93
All sample	43	0.54	0.57	0.61	0.69	0.73

Source: Authors' data analysis

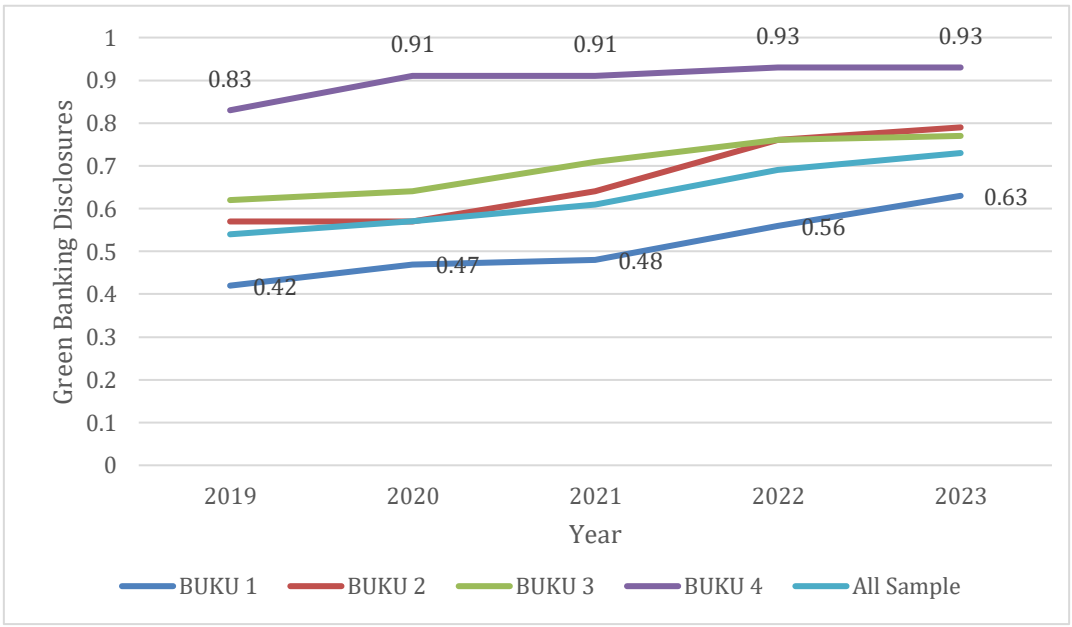

Figure 1: The GBD trends of banks from 2019 to 2023 categorized by BUKU bank size

As depicted in Figure 1 and Table 3, first, for the entire sample (43 banks), the average GBD rose steadily from 0.54 (2019) to 0.73 (2023). The number represents an increase of approximately 19 points (0.19) over five years, indicating that banks are truly responding to sustainable finance obligations and reporting format/content regulations by expanding their green disclosures.

Second, when broken down by the BUKU category, BUKU bank size 1 (19 banks) started from the lowest level of 0.42 (2019), then rose slowly but consistently to 0.63 (2023). This indicates that, despite relatively limited capacity and resources, small banks are still responding to regulatory pressure and the convergence of reporting practices. BUKU bank size 2 (9 banks) started at 0.57 (2019) and ended at 0.79 (2023). This sharp increase, especially after 2021, indicates that mid-sized banks have greater resource space to meet the disclosure standards expected by regulators and the market.

BUKU bank size 3 (11 banks) outperformed BUKU bank size 2 in almost all years, from 0.62 (2019) to 0.77 (2023). The trend is upward but tends to level off towards the end of the period (0.76 to 0.77), which can be interpreted as approaching a relatively high and stable pattern of disclosure levels. BUKU bank size 4 (4 banks) consistently has the highest GBD, from 0.83 (2019) to 0.93 (2023), with the largest increase from 0.83 to 0.91, and then it is relatively stable in the range of 0.91–0.93. This illustrates that the largest banks have been very intensive in disclosing green issues from the outset and have only made marginal improvements over time.

Third, the trend shows that the GBD levels conform to the order BUKU 1 < BUKU 2 < BUKU 3 < BUKU 4 for each observation year. During the time, this difference between groups stays the same, but overall, all of them get better, which leads to a gradual move toward higher disclosure standards. The average increase is most noticeable at the "All sample" level (from 0.61 to 0.69 then increase to 0.73) after the 2021 regulation on the form and content of reports. The pattern is also similar for BUKU 1 and 2, which supports the idea that stricter reporting rules motivate banks, especially smaller ones, to accelerate the improvement of their GBDs.

The early start requirement for BUKU 3 and 4 banks was consistent with what happened in 2019. According to POJK 51/2017, BUKU 3 and 4 banks must start using sustainable finance and write a Sustainability Report for the time period of January 1 to December 31, 2019. Therefore, it's not surprising that their GBD levels were already higher than those of other groups in 2019 (BUKU 3 = 0.62; BUKU 4 = 0.83). At the same time, BUKU 1 and 2 banks only had to make an SR for the time period that began on January 1, 2020. So, the 2019 GBD level for BUKU 1 (0.42) and BUKU 2 (0.57) can be considered a "pre-full obligation" phase.

Entering 2020 and beyond, the rise, especially in BUKU 1 and 2, seems to be in line with the start of the SR obligation for these two groups. BUKU 1 went up from 0.42 in 2019 to 0.47 in 2020 and then kept going up to 0.63 in 2023. BUKU 2 stayed in same GBD level from 0.57 in 2019 to 0.57 in 2020 and then went up quickly to 0.79 in 2023. This means that when the SR deadline started to apply to BUKU 1–2, banks in this group started to meet the requirements for the structure and substance of green disclosures set by POJK 51/2017 (and later clarified by SEOJK 16/2021). At the same time, BUKU 3 and 4, which had an earlier start, were moving toward a GBD level that was already nearly full in the high or very high level of disclosure. This was due to their established status in the green reporting system, which began with the SR obligation in 2019.

3.3 The Impact of SEOJK 16/2021 on GBD

Table 4 shows the paired t-test (or Wilcoxon signed-rank test) to see if there is a difference in the level of GBD after SEOJK 16/2021 was issued. The regulation outlined the rules for how public corporations should write and format their sustainability reports. For banks in BUKU bank size 1-3, we utilize the paired t-test to assess the mean difference; for BUKU bank size 4, we use the Wilcoxon signed-rank test, as the observed sample is only 4 banks.

Table 4: Results of Testing the Difference of GBD before and after SEOJK 2021

Bank Categorization	N	Mean pre regulation (mean rank)	Mean post regulation (mean rank)	t (Z)	Sig (2 tailed)
BUKU 1	19	0.44	0.59	-4.299	0.000***
BUKU 2	9	0.57	0.78	-2.416	0.042**
BUKU 3	11	0.63	0.77	-2.4171	0.036**
BUKU 4	4	(0.00)	(0.00)	(-1.826)	0.068*
All sample	43	0.56	0.71	-5.381	0.000***

**** is significant 1 percent, ** is significant at 5 percent, * is significant at 10 percent*

Source: Authors' data analysis

The results of the pre-post difference test indicate that SEOJK 16/2021 is associated with a clear increase in Green Banking Disclosure (GBD) levels. For the entire sample (43 banks), the average GBD increased from 0.56 (pre-regulation) to 0.71 (post-regulation) with high significance (p = 0.000). Therefore, it can be concluded that the strengthening of regulations on the form and content of reports encouraged listed banks to expand their green disclosures.

When viewed by category, BUKU 1, BUKU 2, and BUKU 3 all showed statistically significant increases in GBD. BUKU 1 increased from 0.44 to 0.59 (p = 0.000), BUKU 2 from 0.57 to 0.78 (p = 0.042), and BUKU 3 from 0.63 to 0.77 (p = 0.036). For BUKU 4, the increase was only significant at the 10% level (p = 0.068), which is reasonable considering their initial GBD levels were already very high and the sample size was very small, thus limiting the scope for growth and statistical power.

Theoretically, this pattern aligns with institutional theory, which emphasizes that regulations act as coercive pressure that encourages organizations to adjust their practices. The issuance of SEOJK 16/2021, which clarified the format and content of reports, encouraged banks, especially those with lower levels of disclosure to improve their GBD to align with regulatory expectations and practices considered "good" in sustainable finance. This study's findings are also consistent with the findings of Ika et al. (2017) and Esa & Ghazali (2012), who showed that the existence of regulations governing the specific content of disclosure contributes to increased disclosure levels, thus strengthening the argument that a strengthened regulatory framework is effective in encouraging convergence of reporting practices among listed Indonesian banks.

3.4 The Different Level of GBD Across Bank Size Categories

Table 5 displays the results of the ANOVA test to assess the research question of whether there are any differences in GBD across BUKU bank size categories.

Table 5: Results of Testing the Difference of GBD Across Bank Size Category

Bank Categorization	N	Mean	F	Sig (2 tailed)
BUKU 1	95	0.51	28.046	0.000***
BUKU 2	45	0.67		
BUKU 3	55	0.70		
BUKU 4	20	0.90		

**** is significant 1 percent*

Source: Authors' data analysis

The ANOVA test results in Table 5 show that the level of Green Banking Disclosure (GBD) differs significantly across bank size categories. The F-value of 28.046 with p = 0.000 indicates that the average GBD of BUKU 1 (0.51), BUKU 2 (0.67), BUKU 3 (0.70), and BUKU 4 (0.90) is not the same, and the pattern forms a clear gradient: the higher the BUKU category, the higher the average GBD. Empirically, this conclusion confirms that bank size as reflected by the BUKU classification is closely related to the intensity of green banking disclosure.

However, these results should not be interpreted simply as if lower GBD in small banks automatically means worse sustainability performance. First, BUKU 1 and some BUKU 2 banks operate with different capital capacities, infrastructure, and reporting teams than BUKU 3 and 4 banks, so the "depth" and "breadth" of their reports are understandably different. Second, the GBD index used in this study is adapted from Bose (2018) and does not explicitly distinguish whether a disclosure item in Indonesia is mandatory or voluntary according to POJK 51/2017 and SEOJK 16/2021. This implies that a higher score signifies the extent of disclosure, but it doesn't directly indicate the level of compliance with minimum regulatory requirements.

From an institutional theory standpoint, these findings indicate that regulatory pressure compels banks to enhance green disclosure, although the response is influenced by resource capacity and business scale. Large banks (BUKU 3 and 4) are better able to internalize regulatory demands into a comprehensive reporting system, while smaller banks are still in the adjustment phase. Therefore, the results of Table 5 should be read as a map of variations in disclosure intensity, rather than a normative ranking of sustainability quality, and open up space for further research that differentiates between mandatory and voluntary items within the Indonesian regulatory framework.

3.5 The Different Levels of Financial Performance Across Bank Size Categories

Table 6 presents the results of the ANOVA test to assess the research question of whether there are any differences in financial performance across BUKU bank size categories. There are four financial ratios namely ROA, CAR, LDR, and NPL which act as a proxy for financial performance.

Table 6: Results of Testing the Difference of Financial Performance Across Bank Size Category

Variable	Bank Categorization	N	Mean	F	Sig (2 tailed)
ROA	BUKU 1	95	0.51	28.046	0.000***
	BUKU 2	45	0.67		
	BUKU 3	55	0.70		
	BUKU 4	20	0.90		
ROA	BUKU 1	95	-0.29	8.998	0.000***
	BUKU 2	45	0.87		
	BUKU 3	55	1.70		
	BUKU 4	20	2.88		
CAR	BUKU 1	95	35.83	7.970	0.000***
	BUKU 2	45	41.47		
	BUKU 3	55	24.33		
	BUKU 4	20	22.08		
LDR	BUKU 1	95	80.75	4.229	0.006***
	BUKU 2	45	95.07		
	BUKU 3	55	89.59		
	BUKU 4	20	80.79		
NPL	BUKU 1	95	1.88	5.689	0.001***
	BUKU 2	45	1.55		
	BUKU 3	55	1.11		
	BUKU 4	20	1.03		

**** is significant 1 percent*

The ANOVA test results indicate that all financial performance indicators (ROA, CAR, LDR, and NPL) differ significantly across BUKU categories, with F-values ranging from 4.229 to 8.998 and a p-value < 0.01. This indicates that the structure of profitability, capitalization, credit distribution, and asset quality are diffrent across the BUKU 1 to BUKU 4 categories. Therefore, the GBD analysis needs to be read in conjunction with the financial profile of each bank group.

In terms of profitability and asset quality, the average ROA shows a clear gradient: BUKU 1 -0.29; BUKU 2 0.87; BUKU 3 1.70; BUKU 4 2.88. This means that the higher the BUKU category, the higher the bank's ability to generate profit from its assets, with BUKU 1 even still experiencing a negative average ROA. This pattern is consistent with the decreasing NPL as the BUKU category increases. The combination of higher ROA and lower

NPLs in BUKU 3–4 indicates that large banks are not only more profitable but also have relatively better asset quality.

For capital and intermediation, CAR is actually highest in BUKU 1 and BUKU 2 (35.83 and 41.47), then lower in BUKU 3 and BUKU 4 (24.33 and 22.08), although all are still well above the regulatory minimum. This can be interpreted as an indication that small and medium-sized banks tend to hold more capital (more conservatively), while large banks optimize it more aggressively. The highest LDR is in BUKU 2 (95.07), followed by BUKU 3 (89.59), while BUKU 1 and BUKU 4 are relatively lower (80.75 and 80.79). This indicates that mid-sized banks (BUKU 2) are the most aggressive in disbursing credit to third-party funds, while small and very large banks are in a more moderate intermediation position.

Overall, these results confirm that differences in GBD levels across BUKU occur within the context of systematically different financial performance profiles. BUKU 3 and 4 banks have higher GBD, higher average ROA, and lower NPLs. On the other hand, BUKU 1–2 banks tend to have more capital but less consistent profitability and asset quality. These findings support the notion that banks' financial capacity and risk profiles affect their ability to invest in green reporting systems. This doesn't mean that smaller banks are worse, but rather indicates that they operate under a different combination of constraints and priorities.

4. Conclusion

This study aims to (1) describe the Green Banking Disclosure (GBD) trends of listed banks in Indonesia during the 2019–2023 period, (2) compare GBD levels across bank size categories (BUKU 1–4), (3) assess whether there are differences in GBD before and after the issuance of SEOJK 16/2021, and (4) compare financial performance (ROA, CAR, NPL, and LDR) across BUKU categories. The analysis indicates that GBD has increased gradually over the years, with BUKU 4 banks consistently having the highest disclosure levels, followed by BUKU 3, BUKU 2, and BUKU 1. GBD levels were found to be higher in the post-SEOJK 16/2021 period, indicating that more detailed regulations regarding the form and content of reports are associated with stronger green disclosure. Furthermore, financial performance also differs significantly across BUKU categories, with larger banks generally exhibiting higher profitability and slightly better asset quality.

These findings support the institutional perspective, stating that when the OJK not only mandated reporting (through POJK 51/2017) but also detailed the structure and content of reports (through SEOJK 16/2021), banks responded by increasing the intensity of GBD. For regulators, these results demonstrate that specific regulations regarding the specific content of disclosure are effective in encouraging more comprehensive reporting practices, although the gap between BUKU 1–2 and BUKU 3–4 remains apparent, signaling the need for capacity building and a more proportionate approach for small and medium-sized banks. For bank management, GBD is increasingly becoming a crucial element of transparency and legitimacy in the eyes of the market, making investment in sustainability governance, data systems, and reporting infrastructure an increasingly relevant strategy, especially for banks already and likely to continue to be subject to sustainability reporting obligations. It is also important to emphasize that lower GBD levels among smaller banks should be understood primarily as differences in reporting depth and capacity, not necessarily an indication of their inherently poorer sustainability performance.

This study uses the GBD index adapted from Bose (2018) without explicitly distinguishing between mandatory and voluntary disclosure items within the Indonesian regulatory framework. Therefore, this index reflects the breadth of disclosure rather than the level of strict legal compliance. Future research is recommended to develop an index that differentiates between mandatory and voluntary items, allowing for analysis of disclosure behavior beyond compliance. Furthermore, the analysis of financial performance in this study is descriptive in nature and does not test the causal relationship between GBD and performance; further research could use panel regression to explore this relationship in more depth. Finally, the focus of this study remains on the quantity of disclosure, rather than the quality, tone, or specificity of the narrative; future studies could utilize text analysis or qualitative approaches (e.g., interviews with regulators and sustainability officials) to understand how green issues are communicated and interpreted by stakeholders.

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Appendix

Table A1. List of Sample Banks Categorized by BUKU Bank size

No	Bank Size Category	Code	Name
	BUKU 4		
1		BBCA	Bank Central Asia Tbk.
2		BBNI	Bank Negara Indonesia (Persero) Tbk.
3		BBRI	Bank Rakyat Indonesia (Persero) Tbk.
4		BMRI	Bank Mandiri (Persero) Tbk.
	BUKU 3		
1		BBTN	Bank Tabungan Negara (Persero) Tbk.
2		BDMN	Bank Danamon Indonesia Tbk.
3		BJBR	Bank Pembangunan Daerah Jawa Barat Tbk.
4		BNGA	Bank CIMB Niaga Tbk
5		BNII	Bank Maybank Indonesia Tbk.
6		BNLI	Bank Permata Tbk.
7		BRIS	Bank Syariah Indonesia Tbk.
8		BTPN	Bank BTPN Tbk.
9		MEGA	Bank Mega Tbk.
10		NISP	Bank OCBC NISP Tbk.
11		PNBN	Bank Pan Indonesia Tbk.
	BUKU 2		
1		ARTO	Bank Jago Tbk.
2		BBHI	Allo Bank Indonesia Tbk.
3		BBKP	Bank Bukopin Tbk.
4		BJTM	Bank Pembangunan Daerah Jawa Timur Tbk.
5		BSIM	Bank Sinarmas Tbk.
6		BTPS	Bank BTPN Syariah Tbk.
7		MAYA	Bank Maypada Internasional Tbk.
8		MCOR	Bank China Construction Bank Indonesia Tbk.
9		SDRA	Bank Woori Saudara Indonesia Tbk.
	BUKU 1		
1		AGRO	Bank Raya Indonesia Tbk.
2		AGRS	Bank IBK Indonesia Tbk.
3		BABP	Bank MNC International Tbk.
4		BACA	Bank Capital Indonesia Tbk.
5		BBMD	Bank Mestika Dharma Tbk.
6		BBYB	Bank Neo Commerce Tbk.
7		BCIC	Bank Jtrust Indonesia Tbk.
8		BEKS	Bank Pembangunan Daerah Banten Tbk.
9		BGTG	Bank Ganesha Tbk.
10		BINA	Bank Ina Perdana Tbk.
11		BKSW	Bank QNB Indonesia Tbk.
12		BMAS	Bank Maspion Indonesia Tbk.
13		BNBA	Bank Bumi Artha Tbk.
14		BSWD	Bank of India Indonesia Tbk.
15		BVIC	Bank Victoria International Tbk.
16		DNAR	Bank Oke Indonesia Tbk.
17		INPC	Bank Artha Graha Internasional Tbk.
18		NOBU	Bank Nationalnobu Tbk.
19		PNBS	Bank Panin Dubai Syariah Tbk.

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Risk Assessment and Mitigation of LNG Export – Permit Delays using ISO 31000:2018 and Decision-Analysis: A Case Study of PT Sulawesi

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Abstract
Liquefied Natural Gas (LNG) export activities in Indonesia operate within a capital-intensive and highly regulated environment, where regulatory uncertainty can translate rapidly into operational disruption and significant financial loss. Following the enactment of Government Regulation No. 61 of 2024, LNG exporters are required to prioritize domestic gas allocation before export approval, introducing timing uncertainty in the issuance of export permits. In 2025, this regulatory transition resulted in recurring LNG export-permit delays for PT Sulawesi, a single-train LNG producer with limited operational flexibility. This study assesses and mitigates the risk of LNG export-permit delays at PT Sulawesi using the ISO 31000:2018 risk management framework, complemented by systems thinking and decision-analysis tools. A qualitative case-study approach is employed, supported by quantitative estimation of financial impacts. Data were obtained from internal company reports, semi-structured interviews with senior management, and official regulatory and policy documents issued by ESDM, SKK Migas, and the Ministry of Trade. Risk mapping, gap analysis, and scenario-based quantitative modelling are applied to estimate revenue at risk and evaluate the effectiveness of existing and proposed controls. The findings show that export-permit delays represent a structural regulatory timing risk rather than a purely administrative issue. The inherent risk score is assessed as high to critical (20), with potential profit downside of approximately USD 40 million at a minimum under a high-exposure scenario. Following mitigation measures and proposed governance enhancements, the residual risk score is reduced to 12. This study contributes empirically by demonstrating the practical application of ISO 31000:2018 combined with decision analysis in managing regulatory risk in LNG operations and provides actionable insights for LNG producers operating under similar regulatory constraints.

Keywords: LNG export permits; regulatory risk; ISO 31000:2018; decision analysis; Enterprise Risk Management; Indonesia

1. Introduction

1.1 Background and Research Context

Liquefied Natural Gas (LNG) projects operate within complex technical, commercial, and regulatory environments, where delays in regulatory approvals can directly translate into material financial losses and

systemic risks across the energy value chain. In capital-intensive and highly regulated industries such as LNG, Enterprise Risk Management (ERM) has increasingly evolved from a compliance-oriented function into a strategic decision-support tool. Empirical evidence suggests that organizations with mature and integrated ERM practices tend to achieve better operational performance and higher firm value, particularly in regulated sectors (Arena et al., 2011; McShane et al., 2011).

ISO 31000:2018 provides an internationally recognized framework for risk management that emphasizes integration with organizational processes, structured and systematic risk assessment, and continual improvement. Prior academic studies in Indonesia, including postgraduate research at Institut Teknologi Bandung, demonstrate the relevance of ISO 31000 in addressing regulatory, operational, and governance risks in energy and infrastructure projects, particularly under conditions of regulatory transition and multi-stakeholder oversight.

In Indonesia, LNG export activities are governed by a layered regulatory framework that prioritizes domestic gas allocation over exports. Government Regulation No. 61 of 2024 mandates the fulfilment of national commodity balances before export approvals are granted. This regulation is operationalized through coordination among the Ministry of Energy and Mineral Resources (ESDM), SKK Migas, the Ministry of Trade, and other government institutions. During the transition period in 2025, increased scrutiny of domestic LNG availability and evolving coordination mechanisms introduced significant uncertainty in export-permit issuance.

For LNG producers such as PT Sulawesi, export-permit delays represent more than an administrative inconvenience. Delays directly affect cargo scheduling, revenue realization, compliance with long-term Sales and Purchase Agreements (SPAs), and production efficiency. As a single-train LNG facility with limited redundancy, PT Sulawesi is particularly exposed to prolonged permit delays and domestic diversion requirements. Prior studies of Indonesian LNG projects, including Tangguh LNG and Bontang LNG, identify regulatory coordination and permit timing as among the most critical non-technical risks affecting project performance.

This study responds to the need for a structured and decision-oriented approach to managing regulatory timing risk in LNG operations. By applying ISO 31000:2018 in combination with systems thinking and decision analysis, the research integrates qualitative risk identification with quantitative estimation of financial exposure. The study positions ERM as an operational and strategic tool to support managerial decision-making under regulatory uncertainty.

1.2 Research Problem and Objectives

In 2025, PT Sulawesi experienced recurring delays in LNG export permits, driven by domestic gas prioritization, regulatory coordination challenges, and transitional implementation of new regulations. These delays posed material risks to commercial performance, operational stability, and contractual compliance. Despite the existence of an ERM framework, export-permit delays were not previously managed as a distinct strategic risk with quantified financial exposure and formal decision-support mechanisms.

Accordingly, this study addresses the following research questions:

1. What controls should PT Sulawesi implement to reduce risks arising from LNG export-permit delays?
2. How effective are PT Sulawesi's current controls in managing export-permit delay risk?
3. What is the potential financial impact on PT Sulawesi and upstream operations if export-permit delays materialize in 2025?

The objectives of this research are to identify and assess export-permit delay risks using ISO 31000:2018, evaluate the adequacy of existing controls, develop a simple quantitative model to estimate revenue at risk, and propose practical mitigation strategies supported by decision analysis.

1.3 Contribution of the Study

This study contributes to both academic literature and managerial practice in three ways. First, it provides an empirical application of ISO 31000:2018 combined with decision analysis in the context of LNG export-permit governance, a topic that remains underexplored in existing ERM literature. Second, it integrates system-level analysis with firm-level risk management, highlighting how national energy policy and regulatory coordination shape corporate risk exposure. Third, it offers actionable governance and decision-support tools, including a decision-tree framework, that can be adapted by LNG producers operating under similar regulatory constraints.

2. Literature Review and Conceptual Framework

2.1 Enterprise Risk Management in Regulated Industries

Enterprise Risk Management has evolved as a holistic approach to identifying, assessing, and managing risks across organizational boundaries. Arena et al. (2011) emphasize that ERM delivers value when it is embedded in decision-making processes rather than treated as a reporting exercise. McShane et al. (2011) further demonstrate a positive association between ERM maturity and firm value, particularly in capital-intensive and regulated industries.

In the energy sector, regulatory risk is consistently identified as a dominant non-technical risk. Studies of LNG and upstream oil and gas projects highlight that permit delays, policy changes, and regulatory coordination failures can generate financial impacts comparable to technical disruptions. Indonesian academic studies applying ISO 31000 confirm its suitability for managing such risks, particularly where regulatory uncertainty and multi-agency governance prevail.

2.2 Regulatory Risk and LNG Export Governance

LNG export governance typically involves multiple government agencies, long planning horizons, and coordination between domestic energy security objectives and international commercial commitments. International best practices observed in Australia, Qatar, and the United States emphasize early regulator engagement, centralized risk ownership, transparent documentation, and digital permit tracking.

In Indonesia, the prioritization of domestic gas allocation introduces a structural timing risk for exporters. While large, multi-train LNG projects such as Tangguh and Bontang benefit from scale, operational buffers, and institutional continuity, smaller single-train projects face heightened exposure to permit delays. This asymmetry underscores the importance of firm-level governance and decision-support mechanisms tailored to regulatory constraints.

2.3 Conceptual Framework

This study integrates three analytical lenses: ISO 31000:2018 risk management, systems thinking, and decision-analysis theory. ISO 31000 provides the structural framework for risk identification, analysis, evaluation, and treatment. Systems thinking, operationalized through causal-loop diagrams, is used to contextualize export-permit delays within a broader governance ecosystem involving regulators, upstream suppliers, domestic demand, and government revenue. Decision-analysis theory, implemented through a decision-tree model, supports sequential and repeatable managerial decision-making under uncertainty.

Together, these lenses form a conceptual framework that treats LNG export-permit delays as a systemic and strategic risk, requiring proactive governance, quantitative foresight, and integrated coordination across organizational and institutional boundaries.

3. Research Methodology

3.1 Research Design

This study adopts a qualitative-dominant case study design complemented by semi-quantitative risk and financial analysis. The case study approach is appropriate given the institutional complexity of LNG export governance in Indonesia and the need to examine regulatory risk within its real-world context. The research is framed within ISO 31000:2018 to ensure systematic identification, analysis, evaluation, and treatment of export-permit delay risk, while decision-analysis theory is applied to structure managerial responses under uncertainty.

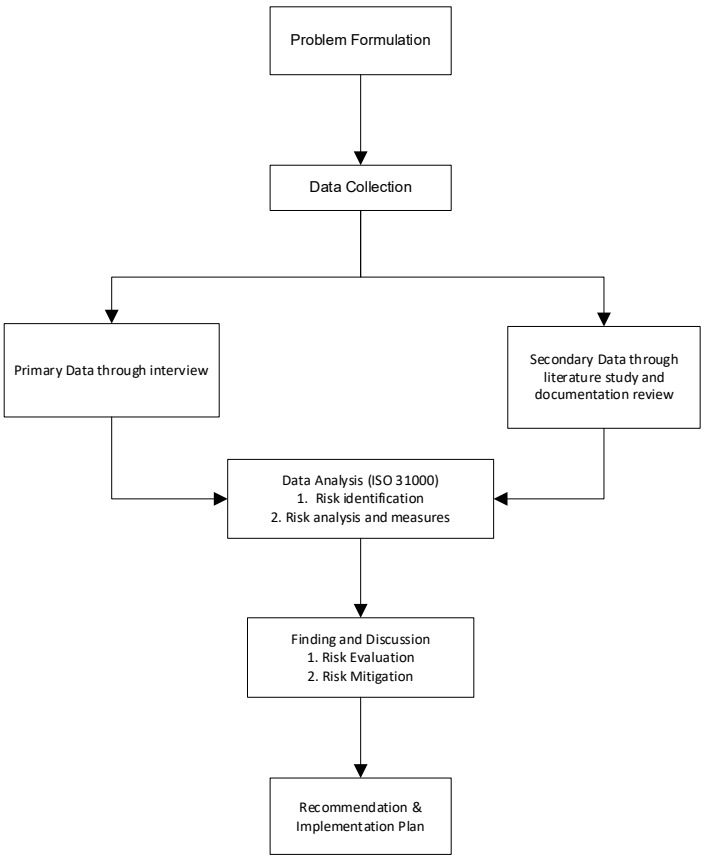

Figure 1: Conceptual Framework Analysing Business Risks

3.2 Data Sources and Triangulation

Data were collected through methodological triangulation to enhance analytical credibility. Primary qualitative data were obtained through semi-structured interviews with PT Sulawesi's high-level management, focusing on permit delays, operational impacts, and decision-making practices. Secondary data included internal company reports, LNG export permit documentation, and operational records for 2025. Regulatory data were sourced from government regulations, ministerial decrees, SKK Migas reports, and official meeting minutes or correspondence where available. Academic literature and industry publications were used to contextualize findings and support benchmarking.

3.3 Analytical Framework and Tools

The analysis integrates four complementary tools. First, ISO 31000:2018 provides the overarching risk-management process. Second, root-cause analysis using a Fishbone diagram identifies structural and organizational drivers of permit delays. Third, systems thinking and causal-loop diagrams capture feedback dynamics between domestic gas demand, regulatory intervention, and operational evidence. Fourth, a decision-

tree model structures alternative responses to diversion requests and permit uncertainty, representing the study's principal analytical contribution.

3.4 Risk Scoring and Quantitative Assessment

Risk likelihood and impact were assessed using PT Sulawesi's internal risk matrix, aligned with ISO 31000 principles. Financial exposure was estimated through scenario analysis comparing baseline export realization with diversion scenarios of <10, 10, and 20 LNG cargoes. While data limitations constrain full probabilistic modelling, the approach provides a conservative and decision-relevant estimate of downside exposure.

4. Results and Discussion

4.1 Inherent Risk Assessment and Gap Analysis

The results confirm that LNG export-permit delays constitute a high to critical inherent risk for PT Sulawesi. Prior to mitigation, the risk scored 20 (impact 5; likelihood 4), reflecting exposure exceeding USD 80 million and a high probability of occurrence. Gap analysis reveals misalignment with ISO 31000 best practice, particularly in fragmented risk ownership, reactive controls, and absence of scenario-based planning.

4.2 Residual Risk after Mitigation

Following mitigation measures implemented in 2025, including intensified regulator engagement and fulfilment of domestic LNG obligations, the residual risk score declined to 12 (impact 4; likelihood 3). This reduction demonstrates improved control effectiveness but confirms that material exposure persists due to systemic factors beyond the company's direct control.

4.3 Quantitative Impact and Sensitivity

Scenario analysis indicates that diversion of up to 10 cargoes can be absorbed with limited financial impact under current compensation mechanisms. However, diversion of 20 cargoes, approximately half of annual production, generates an estimated profit downside of USD 40 million at a minimum. Sensitivity analysis suggests that exposure increases materially if contractual penalties or replacement cargo purchases are required, underscoring the importance of commercial flexibility.

4.4 Managerial Validation through Interviews

Interview findings corroborate analytical results, highlighting domestic supply constraints and unclear regulatory authority as root causes. Management confirmed that decision-making remains largely ad hoc and reactive, reinforcing the need for structured governance and decision-support tools.

4.5 Benchmarking against Tangguh and Bontang LNG

Comparative analysis shows that mature LNG projects treat permitting as a strategic governance issue rather than an administrative task. Tangguh's formal escalation structures and Bontang's institutional continuity contrast with PT Sulawesi's fragmented approach, explaining differential exposure and informing targeted recommendations.

4.6 External Risk Context: PESTEL Analysis

A PESTEL analysis was conducted to establish the external context of LNG export-permit risk, as required under the ISO 31000 context-establishment stage. Politically and legally, the enactment of Government Regulation No. 61 of 2024 formalized domestic gas prioritization, directly constraining export approvals. Institutional overlap among ESDM, SKK Migas, and the Ministry of Trade increased coordination risk during the regulatory transition period.

From an economic perspective, LNG export delays expose PT Sulawesi to deferred revenue, loss of price arbitrage opportunities, and additional logistics costs. Social and environmental dimensions arise from government pressure to secure domestic energy supply and maintain price stability, reinforcing political intervention in export decisions. Technological factors include limitations in digital licensing platforms (SNANK and INSW), which were reported to experience synchronization delays and data validation issues. Collectively, the PESTEL analysis confirms that export-permit delays are driven primarily by structural and policy-related forces rather than firm-level administrative weakness.

4.7 Root-Cause Identification: Fishbone Analysis

Building on the external context, a Fishbone (Ishikawa) diagram was applied to identify root causes of export-permit delays. The analysis categorized causes into regulatory, organizational, process, information, and technical dimensions. Regulatory causes include evolving domestic allocation thresholds and discretionary approval authority. Organizational causes relate to fragmented ownership of permit risk across commercial, regulatory, and operations teams. Process-related issues include sequential approvals and limited escalation mechanisms. Information gaps arise from late-stage requests for revised domestic allocation data, while technical causes relate to digital system outages and inconsistent data standards.

The Fishbone analysis demonstrates that permit delays emerge from the interaction of multiple reinforcing causes, confirming that the risk cannot be mitigated through document completeness controls alone. This finding aligns with ISO 31000 guidance that complex risks require systemic treatment rather than isolated controls.

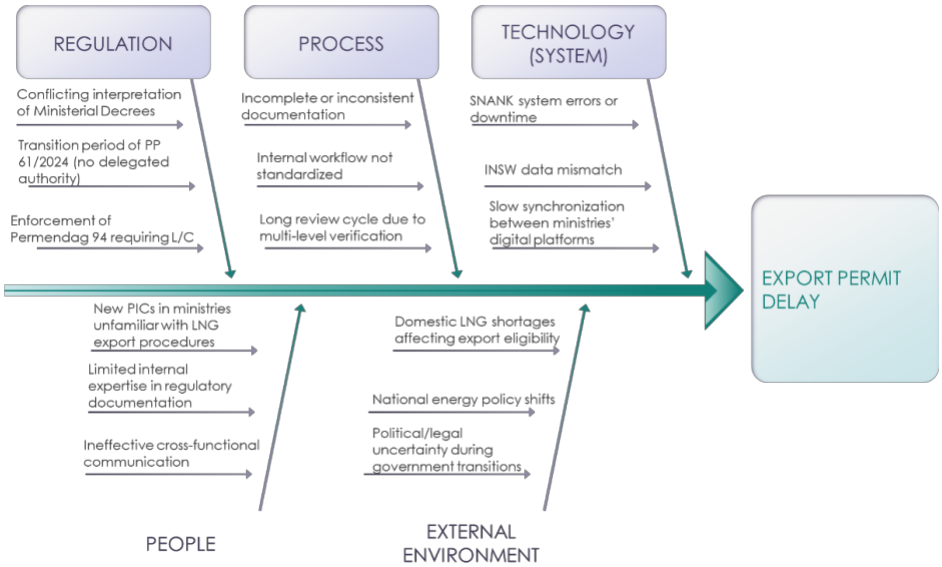

Figure 2: Risk Cause Analysis using Fishbone Diagram

4.8 Dynamic Risk Interaction: Causal Loop Diagram (CLD)

To capture dynamic interactions over time, a Causal Loop Diagram was developed to map feedback relationships between domestic gas demand, regulatory intervention, LNG production, and export outcomes. The CLD identifies a reinforcing loop in which increased domestic demand triggers stricter regulatory oversight, leading to export delays, cargo diversion, and reduced export revenue. Reduced export revenue, in turn, constrains investment flexibility and heightens sensitivity to subsequent regulatory intervention.

A balancing loop is also observed, whereby compliance with domestic allocation reduces immediate regulatory pressure but increases operational and commercial strain on single-train LNG facilities such as PT Sulawesi. The CLD highlights that export-permit delay risk is endogenous to the broader energy governance system and will

persist unless addressed through proactive coordination and anticipatory planning. This systems-based insight explains why reactive permit submission strategies yield limited long-term risk reduction.

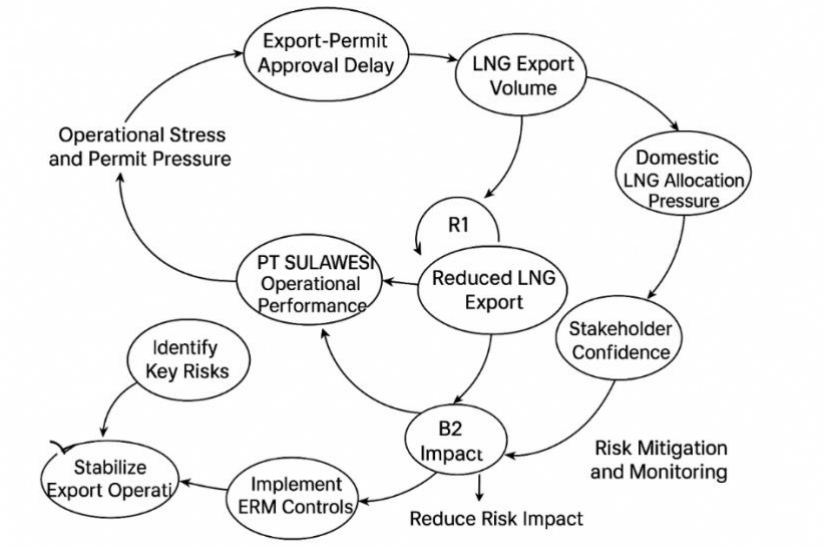

Figure 3: Causal Loop Diagram

4.9 Decision Tree Analysis and Managerial Decision-Making

To address these gaps, a decision tree was developed to structure managerial responses to export-permit uncertainty. The decision tree models sequential choices following a diversion request, including acceptance of domestic diversion, negotiation of export timing, or escalation for regulatory clarification. Each branch incorporates estimated financial outcomes and probability-weighted impacts.

Application of the decision tree demonstrates that early engagement and conditional diversion strategies dominate reactive compliance in expected-value terms. The model transforms permit management from an ad hoc process into a repeatable and auditable decision framework, consistent with ISO 31000's emphasis on integration with organizational decision-making.

Table 1: Outcome Summary

Outcome	**Business Result**	**Upstream Impact**	**GoI Revenue Implication**
Full buyer approval	Optimal	Stable production	Maintained export fiscal intake
Partial approval + appeal success	Manageable	Minor adjustments	Balanced revenue
Mandatory diversion (10 cargoes)	Commercially challenging	Production scheduling pressure	Reduced export revenue
Worst-case 20-cargo diversion	Material corporate exposure	Curtailment / stranded gas	Significant fiscal decline
Permit delay unresolved	Operational disruption	Backlog, inefficiency	Delayed revenue realization

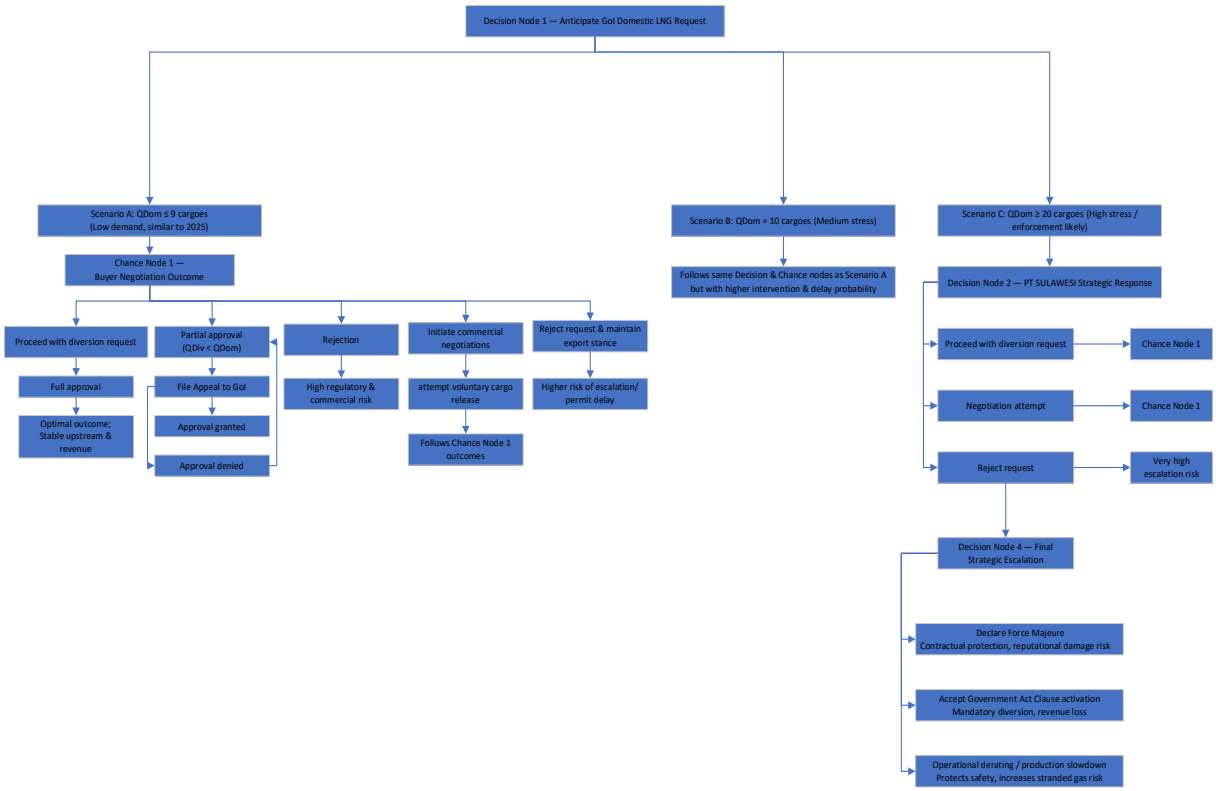

Figure 4: Decision Tree: Managing Export-Permit Delay & Cargo Diversions Scenarios

5. Conclusion

This study demonstrates that LNG export-permit delays at PT Sulawesi represent a systemic regulatory and commercial risk amplified by Indonesia's domestic-first energy policy framework. Current controls provide partial mitigation but remain insufficient under high-stress scenarios. Quantitative analysis estimates a potential downside of USD 40 million in 2025 if severe diversion materializes, confirming the materiality of the risk.

6. Recommendations

The study recommends institutionalizing the decision-tree framework, strengthening proactive government engagement, enhancing contractual flexibility, establishing a dedicated permit governance function, integrating scenario-based budgeting, and supporting regulatory process clarity. Collectively, these measures are projected to reduce permit-delay risk severity by approximately 40% and improve planning certainty.

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Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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Estimating Demographic Effects on Inflation in Japan using the Phillips Curve

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Abstract
The population distribution in Japan has shifted towards advanced ages with lower fertility rates following the so-called baby boom and increased life expectancy over the last few decades. The relation between the change in population composition and the accompanying downturn in economic growth has attracted public interest. Taking these factors into consideration, this study aims to explore the demographic effects on price level in Japan by panel data analysis at the prefectural level. Concretely, our empirical study tries to examine the impact of a change in the relative ratio of younger and older generations on inflation through the estimation with the special type of regional Phillips curve by using the two-way fixed effects model and the Arellano-Bond type GMM method. Our dynamic panel data analysis following the Arellano-Bond type GMM specification finds that a change in the young-age dependency ratio puts inflationary pressures and a change in the old-age dependency ratio applies deflationary pressures on price level.

Keywords: Aging Population, Demography, Old-Age Dependency Ratio, Philipps Curve, Young-Age Dependency Ratio
JEL Classification Code: C33, E31, E52, J11

1. Introduction

In reality, the distribution of population in Japan has shifted to advanced ages with longer life expectancy and lower fertility rates over the last several decades. The total population peaked in 2010, and the working age population has been rapidly decreased since the early 1990s. In addition, old-age dependency ratio has more than doubled since 1990s. Given these facts, there appears to be an increasing concern about the impact of aging and decreasing population on economy.

Anderson *et al.* (2014) and Yoon *et al.* (2014) insist that an aging or an increasing share of old population has significant deflationary effects on economy. Juselius and Takats (2015) and Aksoy *et al.* (2019) find that the full age pattern of population has a huge influence on inflation. McMillan and Baesel (1990) and Lindh and Malmberg (2000) find that the age structure can be a predictor of future trend inflation through their elderly research. On the other hand, Barbiellini *et al.* (2019) insist that aging is likely to dampen inflation by the analysis using regional data of Italy.

Considering the findings of these previous studies, we know that investigation into the relation between demographics and inflation should be conducted. Thus, this paper aims to empirically examine the impact of

Japan's aging population on inflation through the panel data analysis. Concretely, the estimations based on the two-way fixed effects model and the Arellano-Bond type dynamic panel analysis are conducted.

The remainder of this paper is organized as follows. Section 2 explains the data set for our empirical analysis. Section 3 illustrates the structures of the two-way fixed effects model and the dynamic panel data analysis. The result of empirical analysis is described in Section 4. Finally, Section 5 presents the concluding remarks.

2. The Data

This section describes the data set used in our empirical analysis. In our panel data set, each variable includes 5 years (the years 2020 to 2024), and 47 cross-sections (prefectures in Japan) – Hokkaido, Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Niigata, Toyama, Ishikawa, Fukui, Yamanashi, Nagano, Gifu, Shizuoka, Aichi, Mie, Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama, Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, Tokushima, Kagawa, Ehime, Kochi, Fukuoka, Saga, Nagasaki, Kumamoto, Oita. Miyazaki, Kagoshima, Okinawa – are included. The elements described above make the balanced panel. Our dataset is composed of the following variables.[1]

INF: Changes from the previous year of consumer price index (CPI), annual, all items, excluding fresh food, Base year: 2020, annual estimates, unit: %, issued by the Ministry of Internal Affairs and Communications.

YDR: Young-age dependency ratio (Child dependency ratio): Population composition ratio (by age) by Sex, Age (3 groups) and All nationality or Japanese, annual estimates, unit: %, issued by the Ministry of Internal Affairs and Communications.

$$\text{YDR} = 100 \cdot \frac{\text{number of people aged 0 to 14}}{\text{number of people aged 15 to 64}}$$

ODR: Old-age dependency ratio (Elderly dependency ratio, Aged dependency ratio): Population composition ratio (by age) by Sex, Age (4 groups) and All nationality or Japanese, annual estimates, unit: %, issued by the Ministry of Internal Affairs and Communications.

$$\text{ODR} = 100 \cdot \frac{\text{number of people aged 65 and over}}{\text{number of people aged 15 to 64}}$$

UER: Unemployment rate: Unemployment rate by age group, in Reference table, prefectural, by the estimation model, both sexes, Total, percent, quarterly estimates, unit: %, issued by Statistics Bureau, Ministry of Internal Affairs and Communications.

In this study, we should pay careful attention to the city-level annual data on consumer price index (CPI) and its changes from the previous year (as inflation rate). To be specific, statistics of the annual regional consumer price index and the CPI-based inflation rate are observed on the cities that exist in the prefectural capitals and the special wards, or on the cities with large economy. In other words, we cannot obtain their prefectural-level data. Therefore, we have no choice but to utilize the city-level data observed in prefectural capitals as the proxy variables for the prefectural-level data. Quarterly estimates of unemployment rate are converted into annual series by taking the average values of four quarters in each year.

3. Panel Data Analysis

3.1 Two-Way Fixed Effects Model for Panel Data Analysis

The standard linear regression model for panel data analysis can be expressed as

$$y_{it} = \alpha + x_{it}'\beta + u_{it}, \quad (1)$$

where x_{it} is K-dimensional vector of independent variables, i represents the individuals ($i = 1, \ldots, N$) and t is for time period ($t = 1, \ldots, T$). The constant (or intercept) α term is a scaler, and the slope coefficient β is a $K \times 1$ matrix. The α and β are identical for all individuals and for time periods. The disturbance terms are described as

$$u_{it} = \mu_i + v_{it}. \quad (2)$$

[1] The data for our estimation can be retrieved from the website of the "e-stat" (https://www.e-stat.go.jp).

The stochastic variable μ_i denotes the individual-specific unobservable effect, and $E(\mu_i) = 0$. It is time-invariant and explains any individual-specific effect that is not included in the regression. The v_{it} represents the reminder disturbance varying with individuals and with time. For v_{it}, we have the following assumptions:

$E(v_{it}) = 0, Var(v_{it}) = E(v_{it}^2) = \sigma_v^2$, for all i, t. (3)

$E(v_{it}v_{js}) = Cov(v_{it}, v_{js}) = 0$, for $i \neq j$ or $s \neq t$. (4)

We assume that x_{it} is not correlated with v_{is} for all i, s and t. Or, this assumption should be explained in terms of the strong exogeneity:

$E(v_{it}|\mu_i, x_{i1}, x_{i2}, \dots x_{iT}) = 0$. (5)

The so-called "random effects model" in the context of panel data analysis is described with the condition that μ_i and x_{it} are not correlated:

$E(\mu_i x_{it}) = cov(\mu_i, x_{it}) = 0$, (6)

where μ_i represents "random effects." By contrast, the so-called "fixed effects model" in the context of panel data analysis is described with the condition that μ_i and x_{it} are correlated:

$E(\mu_i x_{it}) = cov(\mu_i, x_{it}) \neq 0$, (7)

where μ_i explains "fixed effects." In this case, this model can be expressed as

$y_{it} = \alpha_i + x_{it}'\beta + v_{it}$, (8)

where α_i are fixed unknown constants or fixed (individual) effects, v_{it} is usually assumed to be *i.i.d.* over individuals and time. The overall constant term α in equation (1) is omitted since it is subsumed by α_i in equation (8), which grasp all (un)observable time-invariant differences across individuals. In this specification, consistent estimation does not impose the condition that α_i and x_{it} are uncorrelated.

Further, the u_{it} in equation (1) and (2) can be described as

$u_{it} = \mu_i + c_t + v_{it}$, (9)

where μ_i is the unobservable individual-specific effect. It is individual-invariant and accounts for any time-specific effect that the regression cannot include. The c_t denotes the unobservable time-specific effect that is identical for all individuals, and v_{it} represents reminder stochastic disturbance. In this case, if μ_i and c_t are correlated with x_{it}, we have a special type of fixed effects model, the so called "two-way fixed effects model." On the other hand, if μ_i and c_t are not correlated with x_{it}, we get a special specification, the so called "two-way random effects model."

3.2 Dynamic Panel Data Analysis

Unlike the static models mentioned in previous section, y_{it} depends on its past realizations and y_{it-1} depends on α_i irrespective of the method of the treatment for α_i in a dynamic panel data analysis. The linear dynamic model with exogenous variables and a lagged dependent variable can be described as

$y_{it} = \gamma y_{it-1} + x_{it}'\beta + \alpha_i + v_{it}$, (10)

where x_{it} is uncorrelated with v_{it} for all i and t variables (in short, uncorrelated across individuals and time), or it should be strictly exogenous. The α_i represents fixed individual effects and v_{it} is assumed IID$(0, \sigma_u^2)$. Since y_{it-1} is correlated with α_i (because of the fact that y_{it-1} is a function of α_i), OLS (ordinary lease squares) and GLS (generalized least squares) estimators are inconsistent and biased. In addition, WG (within group) estimators are biased and inconsistent. The reason of the biasedness and inconsistency in this case is that the independent variable will be endogenous (or $\bar{y}_i$ is correlated with $\bar{v}_i$) when we use variable deviations from mean in the transformed model. The so-called first-difference transformation is one of the processes to remove α_i. Concretely, we have the specification:

$\Delta y_{it} = \gamma \Delta y_{it-1} + \Delta x_{it}'\beta + \Delta v_{it}$. (11)

WG and GLS estimators cannot be appropriate. Since Δy_{it-1} has a correlation with Δv_{it}, this specification cannot avoid endogeneity problem.

To control this endogeneity, Arellano and Bond (1991) recommend the procedure that utilizes all possible instrumental variables with GMM (Generalized Method of Moments) estimation. Their study suggest that the list of instruments can be extended by considering additional moment conditions and letting their number vary with t. State differently, their method obtains estimators utilizing the moment conditions given by lagged levels of the dependent variable ($y_{it-2}, y_{it-3}, \dots$) and Δv_{it}. Arellano and Bond (1991) evaluate the validity of estimators given

by GMM, OLS, and WG, and come to their conclusion that GMM estimator has the smallest bias and variance. On the other hand, Anderson and Hsiao (1982) proposed the method by applying Δy_{it-2} or y_{it-2} as the instrumental variables for Δy_{it-1}. Indeed, we obtain more instruments than unknown parameters if the panel for our analysis includes three or more time periods.

4. Empirical Results

With the characteristics of the two-way fixed effects model and the dynamic panel data analysis described in the previous sections, our study proceeds to the empirical analysis that examines demographic effects on inflation through the estimation with the data on Japan's 47 prefectures for period from 2020 to 2024. Concretely, our empirical study tries to examine the impact of change in relative ratio of younger and older generations on inflation through the estimations with the special type of regional Phillips curve by using the two-way fixed effects model and the Arellano-Bond type GMM method. The following two types of specification are applied in our empirical study:

<Model 1> (for fixed effects panel data analysis)

$$INF_{it} = \alpha_i + \beta_1 CYDR_{it} + \beta_2 CODR_{it} + \beta_3 UER_{it} + \varepsilon_{it}, \quad (12)$$

<Model 2> (for dynamic panel data analysis)

$$INF_{it} = \alpha_i + \gamma INF_{it-1} + \beta_1 CYDR_{it} + \beta_2 CODR_{it} + \beta_3 UER_{it} + \varepsilon_{it}, \quad (13)$$

These specifications can be interpreted as the special types of regional Phillips curve where the intercept term captures time (or period) fixed effects and regional demographic variation. Especially, the Model 2 is a kind of regional Phillips curve with backward-looking expectation. In these specifications, the INF_{it} denotes annual inflation for prefecture i at time t. The α_i is the time-invariant fixed effect. The $CYDR_{it}$ is the rate of change of the YDR (young-age dependency ratio). The $CODR_{it}$ is the rate of change of the ODR (old-age dependency ratio). The UER_{it} is the unemployment rate, and this term is included in order to grasp the regional excess demand dynamics. The INF_{it-1} is the lagged inflation rate. It works as the proxy variable for INF_{it}^e based on the assumption of adaptive inflation expectations. The ε_{it} represents the error term. It varies over individuals and time, and captures unobservable all elements that affect INF_{it}.

First, we consider which is better for us to choose the fixed effects model or the random effects model with regard to the model 1. The random effects model can be consistently estimated by both the fixed effects and the random effects estimators. The random effects estimator would be preferred if we are sure that the individual specific effect is certainly an unrelated effect, in short, it is random and uncorrelated with the explanatory variables for all past, current, and future periods of the same agent. The Wu-Hausman test[2] is constructed to find a violation of the assumption for the random effects model insisting that the independent variables are orthogonal to the unit (individual) effects. If no correlation between the independent variables and the unit effects is found, then $\hat{\beta}_{FE}$, estimates of β in the fixed effects model, would be close to $\hat{\beta}_{RE}$, estimates of β in the random effects model. Therefore, the test statistic H is described as

$$H = \left(\hat{\beta}_{RE} - \hat{\beta}_{FE}\right)'\left[Var\left(\hat{\beta}_{FE}\right) - Var\left(\hat{\beta}_{RE}\right)\right]^{-1}\left(\hat{\beta}_{RE} - \hat{\beta}_{FE}\right), \quad (14)$$

with the condition under the null hypothesis:

$$Var\left(\hat{\beta}_{FE} - \hat{\beta}_{RE}\right) = Var\left(\hat{\beta}_{FE}\right) - Var\left(\hat{\beta}_{RE}\right). \quad (15)$$

The H follows chi-square distribution with degrees of freedom that equal to the number of regressors under the null hypothesis of orthogonality. Rejection of null hypothesis[3] implies that the two models are different enough, and we do not prefer the random effects model.

The results of the Wu-Hausman tests for our model 1 is indicated in Table 1. The test statistic shows the rejection of null hypotheses at 1% level of significance. Considering this result, we prefer the fixed effects model for our model 1. However, the Wu-Hausman test has some weak points. For example, it is only valid under *i.i.d.* of error term, and it cannot be applied to the specification that includes time (or period) fixed effects. Considering the latter

[2] The explanation of the Wu-Hausman test in this section is mainly based on Greene (2017) and Verbeek (2017).

[3] Precisely speaking, rejection of null hypothesis should not directly be the evidence for the comparative advantage of the fixed effects model. As to the lower power with respect to the severe pretest bias of the Wu-Hausman test, see Guggenberger (2010).

Table 1: Wu-Hausman Test

Chi-Sq. Statistic	Chi-Sq. d.f.	p-value
190.905424	3	0.0000

Table 2: Redundant Fixed Effects Tests (cross-section and period fixed effects)

F / χ^2	Statistic	d.f.	p-value
Cross-section F	2.826573	(46,135)	0.0000
Cross-section χ^2	126.813419	46	0.0000
Period F	353.043436	(3,135)	0.0000
Period χ^2	409.820945	3	0.0000
Cross-Section / Period F	57.573368	(49,135)	0.0000
Cross-Section / Period χ^2	580.233734	49	0.0000

Table 3: Panel Data Analysis by the Two-Way Fixed Effects Model

Variable	Coefficient	Std. Error	t-Statistic	p-value
const.	2.133102	0.407880	5.229732	0.0000
CYDR	-0.055659	0.034764	-1.601041	0.1117
CODR	-0.115047	0.062378	-1.844339	0.0673
UER	-0.077877	0.173157	-0.449750	0.6536
Effects Specification: Two-way fixed effects model (Cross-section fixed (dummy variables) and Period fixed (dummy variables))				
R-squared	0.971091	Log likelihood		10.40377
Adjusted R-squared	0.959956	F-statistic		87.20914
S.E. of regression	0.270173	Prob (F-statistic)		0.000000
Sum squared resid	9.854089			

Notes: Dependent Variable: INF. Sample Period: 2021 – 2024. Effective Sample Period: 2021 – 2024 (because of the first difference variables). Cross-sections included: 47. Total panel (balanced) observations: 188.

problem, we implement the redundant fixed effects test in order to detect the existence of both cross-section and period fixed effects.

Table 2 depicts the result of the redundant fixed effects (cross-section and period fixed effects) test. The test statistics reveal that the null hypotheses for the individual fixed effects and the period fixed effects are rejected. In addition, the joint null hypotheses are also rejected. The test result implies that there exist the individual effects[4] and the time (or period) effects in the context of the fixed effects model. In this respect, we have to choose the so-called "two-way fixed effects model," explained in Section 3.1, rather than the usual one-way fixed effects model for our estimation.

The result of estimation for the model 1 based on the two-way fixed effects model with our balanced panel data set is displayed in Table 3. Considering the result, no variable (except constant term) is significantly estimated at the conventional level. If I had to say, the rate of change of the old-age dependency ratio is barely significant at 10% with a negative sign. It may imply that population ageing is a deflationary element of inflation. Unfortunately, change of the young-age dependency ratio is not significant even at 10% level of significance. In addition. its estimated sign is negative, but positive one is normally be expected. To put it another way, it is usually assumed that the young-age dependency ratio is an inflationary element of inflation. Thus, the signs of the old-age dependency ratio and the young-age dependency ratio are controversial in this context. On the other hand, the unemployment rate does not work as the factor to affect inflation because of its insignificance. Taken as a whole, the estimation result based on our model 1 does not have any valuable implications.

[4] Because of the existence of individual fixed effects, pooled estimation is inappropriate for us.

Table 4: Arellano-Bond Serial Correlation Test

Test order	m-Statistic	ρ	Std. Error (ρ)	p-value
AR(1)	-3.398583	-109.713931	32.282256	0.0007
AR(2)	2.437673	37.401699	15.343199	0.0148

Notes: Sample: 2020 – 2024. Included observations: 141

Table 5: Panel Data Analysis by the Arellano-Bond-type Dynamic Panel Data Analysis

Variable	Coefficient	Std. Error	t-Statistic	p-value
INF(-1)	0.159618	0.024667	6.470998	0.0000
CYDR	0.139056	0.043467	3.199134	0.0025
CODR	-2.063497	0.088328	-23.36165	0.0000
UER	-2.496321	0.218383	-11.43095	0.0000
Effects Specification: Cross-section fixed (first differences)				
Mean dependent var	0.968085	S.D. dependent var		1.273876
S.E. of regression	1.279599	Sum squared resid		224.3203
J-statistic	34.3643	Instrument rank		30
Prob(J-statistic)	0.126096			

Notes: Dependent Variable: INF. Constant added to instrument list. Method: Panel Generalized Method of Moments. Transformation: First Differences Sample (adjusted): 2022-2024. Periods included: 3. Cross-sections included: 47. Total panel (balanced) observations: 141. White period (period correlation) instrument weighting matrix. White period (cross-section cluster) standard errors and covariance (d.f. corrected). Convergence achieved after 40 weight iterations. Standard error and t-statistic probabilities adjusted for clustering.

In order to get out of this ambiguous situation, we should take a different approach by using the model 2 for estimation. At this stage, one difficulty arises. Under the existent circumstances for data availability, we practically cannot obtain the estimated value of expected inflation rate (π_{it}^{e}) at the prefectural level. Consequently, we have no choice but to use the proxy variable in light of the adaptive expectations hypothesis. Namely, we set the proxy variable as $\pi_{it}^{e} = \pi_{it-1}$. It incidentally captures the degree of inflation persistence in our estimation.

This treatment brings us to a new phase in that the lagged term of dependent variable is included as a regressor in the specification. In other words, a dynamic panel data analysis explained in section 3.2 should be applied. In this study, the Arellano-Bond (1991) type GMM (generalized method of moments) method[5] is utilized to conduct the estimation of dynamic panel specification. No period dummy variable is included in our estimation although it is often used to control period fixed effect, and the first difference transformation is applied[6] to each variable in order to remove cross-section fixed effects. As the Arellano-Bond type dynamic panel instrumental variables with lags – INF_{t-1}, $CDYR_{t-1}$, $CODR_{t-1}$, UER_{t-1}– are adopted in addition to the usual instruments for GMM (with transformation by taking differences) – *CYDR*, *CODR*, *UER* –. The White period GMM weighting matrix and robust (White) standard errors are applied. Further, the procedure of n-step iterations to convergence is utilized.

Table 4 shows the result of Arellano-Bond Serial Correlation Test for serial correlation in the error terms. The null hypothesis is that there is no serial correlation of a given order. The test statistic is computed as proposed by Arellano and Bond (1991) and Arellano (2003). The test result of AR(1) with respect to the first difference of the error term shows that the null hypothesis cannot be rejected, while the result of AR(2) displays that the null hypothesis is rejected at 5% level of significance. These results do not contradict our assumption.

Table 5 describes the estimation result of dynamic panel data analysis based on the Arellano-Bond type specification. As mentioned before, the procedure of n-step iterations to convergence is adopted. The convergence of our estimation was achieved after 40 weight iterations. First, we should check the result of the Hansen test (of overidentifying restrictions validity) in order to examine the suitability of the instrumental variables. In this case, the null hypothesis is that the instrumental variables are not over-identified. The probability for J-statistic in the bottom row of Table 5 shows that the null hypothesis is not rejected at the conventional level. Thus, we need not

[5] For the Arellano-Bond type GMM estimation, see Arellano and Bond (1991), Pesaran (2015), Verbeek (2017), and Baltagi (2021) for details.
[6] If the innovations of the variables are *i.i.d..,* the transformed innovations follow an integrated MA(1) process.

re-consider or replace the instrumental variables. Regarding the estimated four coefficients, INF_{t-1}, the proxy variable for expected inflation rate, is significantly estimated at 1% level of significance. Change of the young-age dependency ratio is significant with a positive sign, while the rate of change of the old-age dependency ratio is also significant with a negative sign. This combination is consistent with the usual assumption – the young-age dependency ratio is an inflationary element and the old-age dependency ratio is a deflationary element –. The estimated coefficient of unemployment rate is significant with a negative sign. It is consistent with the expected condition.

Considering the results of estimations comprehensively, it can be concluded that our dynamic panel data analysis by utilizing the Arellano-Bond type specification suggests comparatively clear implication compared with the two-way fixed effects model. Namely, we find that a change in the young-age dependency ratio puts inflationary pressures and a change in the old-age dependency ratio applies deflationary pressures on price level.

5. Concluding Remarks

Considering the findings of the previous studies, we know that investigation into the relation between demographics and inflation should be conducted. Therefore, this study aims to empirically examine the impact of Japan's aging population on inflation by utilizing the panel data analysis. The estimations by using the two-way fixed effects model and the Arellano-Bond type dynamic panel specification based on a kind of backward-looking regional Phillips curve are conducted with Japan's data on 47 prefectures for the period from 2020 to 2024. Concretely, our empirical study tries to examine whether an increase in the relative ratio of older generation has deflationary pressures and increase in the younger generation's relative ratio has inflationary pressures on price level.

The result of the estimation for the model 1 by following the two-way fixed effects model shows no valuable information. If I had to say, the rate of change of the old-age dependency ratio is barely significant at 10% level of significance with a negative sign. It may imply that population ageing is a deflationary element of inflation. Unfortunately, change of the young-age dependency ratio is not significant even at 10% level with unexpected sign. In addition, the unemployment rate does not work as the factor to affect inflation.

On the other hand, our dynamic panel data analysis following the Arellano-Bond type GMM specification based on the model 2 suggests comparatively clear implication about the impacts of the young-age dependency ratio and the old-age dependency ratio on inflation. Concretely, we find that a change in the young-age dependency ratio puts inflationary pressures and a change in the old-age dependency ratio applies deflationary pressures on price level. The estimated coefficient of unemployment rate is significant with a negative sign. It is consistent with the expected condition.

The findings of our empirical study could be applied to some regional economic policies at the micro- and macro-levels. However, a natural extension and further investigation of our research topic are required since the empirical analysis in this paper has some uncertain factors.

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The Impact of Green Investment Practices on Economic Growth Strategies in the Libyan Companies

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Abstract
The current study focuses on the significance of green investments as a part of Libya's economic growth strategies during the period 2008 to 2023 and relies on secondary data acquired from trustful institutional sources, such as the World Bank, African Development Bank (AfDB), International Renewable Energy Agency (IRENA), and United Nations Development Program (UNDP). The researcher employed a quantitative descriptive method for the analysis, with the goal to unveil the interconnections of the factors: renewable energy investment, energy efficiency, CO_2 emissions, and environmental expenditure, with GDP growth, diversification, and productivity. The results reveal that both renewable energy investment and energy efficiency are economically rewarded while the increase of carbon emissions is punished. Furthermore, the results point out that in order to achieve the diversity, long-term robustness, and synchronization with the world's sustainability objectives, the green investment should be deeply rooted in the national economic agenda of Libya. The policy implications reveal that institutional reforms, the creation of green financing mechanisms, and the establishment of strong regulatory framework are prerequisites to the success of Libya's transition towards a low-carbon innovation-driven growth model.

Keywords: Green Investment, Economic Growth, Renewable Energy, Sustainability, Libya, Energy Efficiency

1. Introduction

The global concerns about the fast-changing climate, the environment slowly deteriorating, and the getting-less resources has made the sustainable development strategies more urgent, thus, the governments and firms have been forced to think about the environment in their economic planning. Green investments—money put into projects that are environmentally friendly, become less polluting, more resource efficient, and the transitions to a low-carbon world—have become a major partner in the environment and economy coupling. Green investment as noted, incorporates ways of producing electricity with the sun and wind, non-polluting means of getting people and goods from one place to another, and the use of earth-friendly technology and even the building of green infrastructure, thus giving the economies the chance to grow without putting more pressure on nature.

There is an impressive amount of articles that back up the claim of green investments to be a driving force for innovation, productivity and competitive advantage. The ability to lead the market because of the technology developed and being able to operate for a long time without risks are among the reasons for the schools of thought to have come up with such conclusions. As such, according to the studies referred to in the thesis, the firms that are doing environmental innovation get benefits in terms of efficiency, compliance with regulations, and being trusted by stakeholders, while the economies of the countries as a whole receive benefits in terms of jobs, diversification, and eco-resilience (Chen & Ma, 2021; Doval & Negulescu, 2014). To sum up, these findings view green investment as a tool for both economic and environmental purposes, leading the countries' development paths to be in line with the current sustainability requirements.

The situation is even more critical for Libya when we come to the matter of the strategic necessity for green investment. The Libyan economy has always been mainly supported by oil and gas and this sort of reliance makes the country susceptible to market price fluctuations, environmental degradation and weak governance. The dissertation draws attention to the fact that Libya is in dire straits with respect to three problems: the environment being degraded, little diversity in the economy, and the lack of proper policies in place for going green. Although the country is endowed with extensive solar and wind resources, large-scale renewable energy installment and green infrastructures are still very much in the offing owing to the weak institutions, lack of incentives and absence of coordinated national strategies for sustainability.

On the flip side, Libya's post-conflict healing phase is the time when the country can transfer the sustainability principles to reforms in the economy. The UNDP, AfDB and the Green Climate Fund are among the international organizations that have already initiated aid-programs to enhance the capacities of the local authorities, thus, the policies regarding green finance, climate resilience, and renewable-energy integrative approaches are going to be receiving more attention. Furthermore, the thesis pointed out that green investment was the right thing to do for Libya since it entailed the transformation of the economy through the creation of new industries, green jobs, less dependence on oil, plus a more stable and better economy in the future.

The research work presented in the thesis cites the correlation between solar and wind power investments and their positive impact on energy-efficient GDP growth as a strong one. CO_2 emissions, on the other hand, have been found to significantly correlate with the negative side of economic performance. The Indian and African studies done also confirm this and the results are in line with the global and regional studies that green investments not only promote growth but also reduce environmental pollution, and thereby, the economic expansion is no longer viewed as a negation of ecological sustainability.

Therefore, the purpose of this article is to distill the theoretical underpinnings, methodological approach, and the main empirical findings of the thesis so that a targeted and publishable academic study can be produced. It analyses the impact of the green investment practices on economic growth strategies in Libya and signals the policy pathways that could speed up its transition toward a resilient, diversified and low-carbon economy. The introduction lays out the conceptual and contextual foundation for the analysis and provides a solid understanding of the reasons why green investment is now a must for the long-term development path of Libya.

2. Literature Review

2.1. Empirical Evidence from Global and Regional Studies

The global shift toward sustainability and low-carbon growth has made the empirical link between green investments and economic development a hot topic for researchers. There is evidence that green investments, when accompanied by new technology, strong institutional ability, and determined supportive policies, can boost economic growth in both developed and developing nations. The investments indicated above are linked to advances in GDP growth capacity, energy efficiency, the transition to a green economy, and environmental issues including carbon emissions and resource depletion, according to empirical findings (Zhang et al., 2022).

The dynamic nexus of green investment, economic growth, natural resource consumption, and green technological innovation was examined in a thorough research effort carried out in China by Zhang et al. (2022). It is possible that investments with an emphasis on the environment could be a powerful force in bringing about ecological modernization and sustainable development, since their findings corroborated a strong positive linear relationship between green investment and GDP growth. On top of that, their research shows that green investments have more of an impact on the economy in the long run when they combine environmental factors with technological advancements, and it also shows that regional innovation capacities can boost the economic advantages of green investments.

Similarly, a panel analysis of Chinese provinces conducted by Wan and Sheng (2022) shows that green investment leads to higher clean energy consumption, which in turn stimulates economic growth and decreases carbon emissions. It shows that green investment promotes economic development and environmental sustainability simultaneously, which is especially true in economies that rely heavily on energy.

Green investment, in conjunction with technical innovation, is critical in reducing CO2 emissions and reflects favorably on the relationship with economic growth, according to Luo, Ullah, and Ali (2021), who offered a broader Asian viewpoint by mentioning a few chosen Asian countries. Their research proves that considering sustainability when making investments is not a compromise, but rather a win-win that helps the economy and the planet.

Kwilinski, Lyulyov, and Pimonenko (2023) were worried about the potential worldwide impact of greenfield investment on green growth promotion. Their findings provide credence to the idea that greenfield investments in sustainable agriculture, green infrastructure, and renewable energy can improve economic production and job creation while also helping to achieve climate goals. It has been shown that these investments boost productivity without compromising the environment, in line with sustainable development ideals.

Particularly after the financial crisis, "green investments" and "green innovations" are crucial to recovery plans, according to Zenghelis (2012). Countries can boost employment, productivity, and investor confidence by investing in clean technology and high-quality low-carbon infrastructure. In his policy brief, he stresses the need for fiscal stimulus programs that include green investments in order to build economic resilience for the long run. Additionally, Fan et al. (2023) discovered that green investment, along with developments in ICT, substantially helps the government achieve its sustainability goals in relation to economic growth goals. Digital change, green financing, and economic growth are all interdependent, as their research shows.

Green investment, according to Kaur and Tanwar (2024), helps in several areas of sustainable development, including innovation-driven competitiveness, inclusive growth, and resource efficiency. Incorporating green investment into national development strategies for balanced and inclusive economic growth will be made easier with the empirical evidence given by their research.

2.2. Green Innovation and Firm Competitiveness

As the world moves toward sustainable development, green innovation has emerged as a crucial factor in improving firm-level competitiveness. This is due to the mounting positive evidence from consumer choices, regulatory frameworks, and investor behavior, which has led firms to see green innovation as essential to their long-term survival and competitive advantage, rather than just a voluntary act of corporate responsibility (Zhang et al., 2022).

Green innovation is favorably associated with corporate competitiveness, according to the empirical studies. Therefore, in regards to the Chinese economy, Zhang et al. (2022) found that energy-intensive industries, in particular, had a notable improvement in performance on two tiers of businesses due to green technology advancements driven by focused green investment. The gains are a result of more efficient operations, reduced production costs over time, and a better image as a brand among eco-conscious consumers. These findings provide

more evidence that green innovation helps businesses stay competitive both at home and abroad by ensuring that their practices meet the growing demands of consumers and environmental regulations.

Access to green financing and benefits, as well as the chance to comply with stricter environmental regulations, are two ways in which green innovation gives businesses an edge. New delivery services should be involved in the flexible adoption of green technology under the best resource management, according to Wan and Sheng (2022). Because they are better able to satisfy most legislative criteria and/or financial conditions related to energy efficiency and carbon emissions, businesses that have adopted environmentally friendly technologies can enjoy preferential financing and reduced compliance costs.

Green innovation opens the door to product and process differentiation, two key sources of competitive advantage, which in turn boosts firms' competitiveness. According to Kaur and Tanwar (2024), eco-innovation is a major market trend that could offer developers and innovators an edge over their competitors. This is because, for example, eco-friendly products, energy-efficient appliances, and non-polluting vehicles are practically unheard of in the market. Businesses that differentiate themselves in this way not only attract new consumers, but also hold on to the ones they already have. People are willing to pay a premium for eco-friendly products, so when these products are promoted effectively, sales can be rather high.

In the context of Green Innovation, investments in the environment have emerged as a hot topic. Green financing and public policies create an environment where businesses and their partners are more likely to invest in R&D for environmentally friendly processes and goods, according to research by Kwilinski, Lyulyov, and Pimonenko (2023). Green practices spread throughout businesses and investments in research and development spur technical advancements, which in turn benefit the economy and the environment. Particularly in emerging markets with less innovation potential, these investments often usher in cutting-edge sustainable technology and management methods.

In their 2023 publication, Fan et al. further expound on these synergistic links of digital technology and green innovation. According to their research, green innovations like predictive maintenance tools, automatic waste segregation, and smart energy management systems all benefit from the integration of ICT. These structures have a multiplicative effect on competitive advantage because they boost environmental performance while simultaneously enhancing the agility and cost of labor behavior.

Economic leaders may secure a leg up in the upcoming wave of industrial change by investing in green innovation early on, claims Zenghelis (2012). With decarbonization as a worldwide trend, being an early adopter of green technology may provide the biggest rewards in terms of price advantages and favorable trade relations, thus it is important to look at the big picture.

3. Methodology

The research employs a quantitative, descriptive, and analytical methodology relying solely on secondary data to scrutinize the effect of green investment practices on Libya’s economic growth strategies during 2008-2023. The selection of secondary-data-based method is in line with macro-level sustainability research, especially in places where institutional instability and data-collection constraints hinder the practicality of primary surveys. Datasets collected from reputable global agencies— including World Bank (WDI), African Development Bank (AfDB), International Renewable Energy Agency (IRENA), UNDP, IMF, and UNCTAD— that were used in the study, are cited in the thesis for ensuring the reliability, comparability, and replicability of the research over time and across regions.

By means of drawing up theoretical propositions based on sustainable development theory, environmental economics, and green growth schemes, the research has a deductive rationale and then empirically verifies the propositions that are relevant to Libya’s economic and environmental situation using empirical indicators. The study comprises both longitudinal and cross-sectional facets: the longitudinal aspect is responsible for recording the changing trends happening in Libya's economy during the fifteen years-long period, while the cross-sectional

comparisons have the MENA countries of Tunisia, Egypt, and Algeria singled out to provide the context of regional development for Libya's performance. This dual method enhances both the internal and external validity of the findings.

Research made use of the annual dataset that contained data on green investment variables, which include renewable energy investment, renewable energy capacity, energy efficiency indicators, CO_2 emissions per capita, and environmental spending, along with principal economic growth measures, i.e., GDP growth, GDP per capita, productivity, and sectoral diversification indices. These variables have been selected, because they are common in global empirical research and can be found in credible institutional databases. Meanwhile, the missing data points were handled using interpolation methods that are in accordance with AfDB statistical protocols to ensure the smoothness of the data and minimize the chance of bias.

There are two major phases in the analytical procedure. At the first stage, the descriptive statistical methods are used to throw light on the trends in green investment and the economy across the study period. This also involves looking into the yearly variations in renewable energy installation, emission levels, and GDP growth paths. In the second phase, inferential analysis is carried out by means of correlation matrices and multiple linear regression models to express the direction and strength of the associations between green investment and economic growth variables quantitatively. For data cleansing, statistical calculations, and results illustration SPSS 25.0 and Microsoft Excel were the two software applications used. The regression model used allows one to measure both the independent and combined effects of renewable energy investment, energy efficiency, and CO_2 emissions which are the main enablers, by having GDP growth as the dependent variable.

In the end, the methodological framework embraces the interpretation of institutions and policies besides the numerical results, thereby guaranteeing that statistical outcomes are linked to the larger political, economic, and environmental contexts of Libya. Thus, the mixed descriptive-analytical design not only improves the explanatory power of the study but also offers insights that are relevant for policy making in Libya’s green transition.

4. Results

The investigation's findings depict an interconnected scenario concerning the trends of green investments in Libya and their impact on economic growth from 2008 to 2023. The analysis based on descriptions discloses a considerable swing in the macroeconomic indicators of Libya, which was mainly caused by the prevailing political instability and oil production that kept changing. As per Table 1, the growth of GDP was marked by very drastic contractions during the periods of conflict and temporary recoveries during the times when stabilizing oil output was taking place, demonstrating the vulnerability of Libya's growth model as well as its reliance on hydrocarbons.

Table 1: Libya GDP Growth and Key Economic Indicators (2008–2023)

Year	Real GDP Growth (%)	Inflation (%)	FDI Inflows (% of GDP)	Oil Output (‘000 bbl/day)	Unemployment (%)
2008	6.3	9.6	4.2	1,680	18.5
2011	–62.0	15.1	0.3	390	27.4
2012	76.3	6.1	2.8	1,530	20.2
2016	–3.0	24.5	1.0	620	21.9
2020	–31.3	22.0	0.5	360	25.0
2023	3.2	9.0	1.6	1,170	19.3

Reference: World Bank (2024), IMF (2023), AfDB (2023).

Libya's green investment metrics over the analyzed time frame have shown slow but still limited development. The data displayed in Table 2 shows that the capacity of renewable energy was still very small until the early 2010s, and only then were there small changes that followed the establishment of international collaboration and the UNDP-financed programs aimed at making Libya energy-efficient. Apart from that, the extent of the deployment of renewable energy was still very small when compared to Libya's vast solar potential. The energy-efficiency categories reflected the slight advancements that were caused by occasional investments in the

upgrading of the old infrastructure and the loss of electricity through transmission lines. On the other hand, CO_2 emissions per person continued to be very high until they were a clear indicator that the country was still overly reliant on fossil fuels and that there was not much diversification in the mix of energies used.

Table 2: Renewable Energy and Green Investment Indicators in Libya (2010–2023)

Year	Installed Renewable Capacity (MW)	Renewable Share of Electricity (%)	Energy Intensity (MJ/USD GDP)	CO_2 Emissions (t per capita)	Government Spending on Environmental Projects (% of GDP)
2010	5	0.2	7.8	8.9	0.1
2015	22	0.6	7.5	8.2	0.2
2018	80	1.1	7.3	7.8	0.3
2020	120	2.0	7.1	7.5	0.4
2023	160	2.8	6.9	7.2	0.5

Reference: IRENA (2024); UNDP (2023); Libyan Renewable Energy Authority (2023).

The economic structure of Libya, which is depicted in Table 3, further emphasizes the hydrocarbon sector's supremacy. Even though the authorities were talking about diversification, the non-oil industries such as manufacturing, agriculture and, and services recorded only small-scale growth. The diversification index reveals that the Libyan economy was still dependent on oil revenues to a great extent, hence weakening its ability to withstand crises and making it difficult to achieve long-term sustainable growth. Such structural factors should be taken into account when assessing the interaction between the changes in GDP and the green investment variables.

Table 3: Sectoral Composition of GDP and Diversification Index (2010–2023)

Sector	2010 Share of GDP (%)	2023 Share of GDP (%)	Average Growth (%)	Comment
Oil and Gas	67	55	–0.9	Still dominant but declining share after 2016
Construction	7	10	+2.3	Growth linked to reconstruction projects
Trade & Services	9	13	+1.9	Gradual expansion in urban centres
Manufacturing	6	8	+1.6	Slow progress due to energy constraints
Agriculture	3	3	0.0	Minimal change over period
Diversification Index (0–1)	0.23	0.31	+0.8	Incremental improvement post-2016

Reference: World Bank (2024); UNDP (2023); AfDB (2023).

The outcomes of the regression analysis present strong empirical support regarding the influence of green investment indicators on economic growth. The data in Table 4 exhibit the conclusions of the multiple regression model, signaling a statistically significant positive outcome of the renewable-energy investment on GDP growth. This implies that the economic growth will not be very noticeable if there are only minor additions to the renewable-energy application, but rather, they would be there through the process of cutting down the energy inefficiencies and encouraging people to spend money in the local areas that are involved. The quality of energy used was also contributing positively to GDP, where energy optimization being globally accepted as reducing operational costs and increasing productivity fits with the situation. On the contrary, CO_2 was deemed to have a negative and a statistically significant impact on the economic growth of the country, suggesting that, the case of the country might be that the higher CO_2, the lower the economy which is possibly the outcome of the environmental degradation, higher medical costs in public due to pollution and less efficient institutions made so by fossil-fuel dependence.

Table 4: Regression Results: Effects of Green Investment Variables on GDP Growth (Libya, 2008–2023)

Variable	Coefficient (β)	Std. Error	t-Statistic	p-Value	Interpretation

Constant (α)	0.92	0.38	2.41	0.03	Baseline GDP growth rate
Renewable Investment (REINV)	**0.47**	0.18	2.61	**0.02**	Positive and significant impact
CO_2 Emissions (CO_2)	**–0.35**	0.15	–2.33	**0.03**	Negative and significant relationship
Energy Efficiency (ENEFF)	**0.29**	0.14	2.07	**0.04**	Efficiency improvements enhance GDP
FDI Inflows (FDI)	0.21	0.16	1.31	0.19	Positive but not statistically significant
Inflation (INF)	–0.18	0.10	–1.80	0.09	Weak negative relationship
$R^2 = 0.69$	**Adjusted R^2 = 0.62**	**F-statistic = 9.87 (p = 0.001)**			

Reference: Author's computation based on World Bank (2024), IRENA (2024), UNDP (2023), AfDB (2023).

The results of regional comparison, depicted in Table 5, show that Libya is trailing behind its neighboring countries of Tunisia, Morocco, and Egypt when it comes to the aspects of renewable energy usage, diversification of energy sources, and investment in green infrastructure. The mentioned nations are indicative of not only making a continuous progress in terms of green-energy capacity but also of being able to harmonize and collaborate with the global trend of sustainability. The status of Libya being the one with the least chances in the region signifies the lost possibilities that are a result of the slow pace of green investment strategies' adoption.

Table 5: Selected Green Investment and Economic Growth Indicators in North Africa (2010–2023)

Indicator (2023)	**Libya**	**Tunisia**	**Egypt**	**Morocco**	**Regional Mean (MENA)**
Renewable-Energy Share of Electricity (%)	2.8	17.5	12.3	37.1	18.7
Installed Renewable Capacity (MW)	160	1,100	6,800	4,700	3,400
Energy Intensity (MJ/USD GDP)	6.9	3.8	4.1	3.6	4.5
CO_2 Emissions (t per capita)	7.2	5.0	2.9	2.2	4.3
Real GDP Growth (2008–2023 avg %)	–1.8	2.4	4.2	3.5	3.0
Diversification Index (0–1 scale)	0.31	0.46	0.55	0.61	0.45
Government Environmental Expenditure (% GDP)	0.5	1.4	1.1	1.6	1.2

Reference: World Bank (2024); IRENA (2024); UNDP (2023); AfDB (2023).

The findings overall lead to the conclusion that there was a definite and measurable correlation between the green investments and the economic performance of Libya. Investments in the solar energy sector and energy-efficient improvements are identified as the main drivers of the GDP growth, while high carbon dioxide emissions are limiting the country's capacity to grow economically. The evidence provided, notwithstanding the structural and institutional challenges that Libya faces, the economically strategic potential of green investment as part of the national growth planning stays confirmed.

5. Discussion

The results of the study provide very strong support that the green investment practices not only have an economic impact but also contribute to Libya's economic growth trajectory. The regression analysis reveals that the investments in renewable energy and energy-efficiency upgrades have a favorable impact on GDP growth which is in accord with the global empirical patterns that the green investments have been reducing the costs of energy and stimulating structural modernization. These results have given support to the theoretical expectations derived from the sustainable development and green growth theories that environmentally friendly investments can lead to both economic growth and less ecological risks in the long run.

The negative and statistically significant correlation between CO_2 emissions and GDP growth has again provided substantiation for the environmental economics viewpoint that the diminishing of the environment has a bearing on the economic side as it imposes certain costs. The Libyan situation is such that high emissions are associated with the antiquated energy infrastructure, low productivity, and unyielding dependence on fossil fuels which altogether make the economy unsustainable. Thus, this economic loss has made the necessity of emissions reduction an even more pressing issue for the economy rather than an environmental goal only. According to the thesis, Libya's inability to shift to different sources of energy leads to long-term stability limitations together with the rise in vulnerability to external shocks especially that of global oil price fluctuations.

Comparisons on a regional basis highlight the unfavorable position of Libya when compared with neighboring countries that have put in place more aggressive green investments. For example, Morocco and Egypt have gone ahead with large renewable-energy projects and also established clear institutional frameworks for the private sector to take part easily. Libya is facing challenges such as the splitting of its institutions into factions, lack of the requisite supportive policies, and poor green-finance mechanisms all of which have hindered the country from making progress similar to that of the countries mentioned above. This view concurs with the thesis that poor regulatory clarity and lack of incentives discourage the local and also foreign investors from taking part in the green projects.

These findings back up the claim that green investment can make it easier for economic diversification—this being the most urgent development goal for Libya. The green investments through injecting into the sectors such as non-oil, renewable energy, sustainable manufacturing, and environmental services would assist in erecting a more tough economic structure that is somewhat less reliant on the unpredictable revenues from hydrocarbons. This is in line with the wider national priorities as pointed out in the international assessments by AfDB and UNDP which highlight the green transition as one of the main features of Libya's rebuilding and economic reform process.

In general the findings bring to light a very large and still unutilized opportunity: though Libya has a lot to offer in renewable-energy resources and there is also a growing awareness of the sustainability challenges the country is facing, the institutional weakness has not allowed the successful mobilization of green capital. On the other hand, reinforcing governance, moving towards the adoption of coherent green-alternating-investment policies, and increasing the public's accessibility to green finance can tremendously speed up the changing of Libya into a low-carbon, diversified, and innovation-oriented economy.

6. Conclusion

The research analyzed the influence of green investment practices on the economic growth strategies of Libya from 2008 to 2023 and gave empirical proof that the investment in renewable energy and the application of energy-efficient measures have a positive impact on the economy whereas high CO_2 emissions impede growth. The study results suggest that investing in an eco-friendly manner is not only conflicting with economic growth but can also be a driving force behind it, especially allowed in countries that are trying to change their reliance on resources as the main economic structure.

The evaluation points out the considerable but largely unexploited potential of Libya for green investments. Although the country has an abundance of solar and wind resources, the renewable energy sector has got a little attention because of divided institutions, unstable policies, and a lack of proper financing. What the results show is that even the little increase in renewable energy investment has a measurable positive effect on GDP growth, thus, suggesting that the larger scale initiatives could lead to significant long-term benefits in stability and sustainability of the economy.

On the other hand, a very important conclusion drawn is that the reduction of emissions has to be part of Libya's economic planning. The relationship between CO_2 emissions and GDP growth being negative indicates the economic losses caused by environmental degradation and at the same time, it points out the need for better energy

efficiency, modernized infrastructure, and a diversified national energy mix. It is necessary to confront these structural limitations, to be economically resilient and to keep in line with global sustainability commitments.

The research results also suggest that Libya's geographical location is indicative of a lost chance. Countries in the MENA region which are close to Libya have made strides in the areas of green finance, renewable energy, and institutional reform which puts more emphasis on the need for coherent policy frameworks. Libya can gain from the adoption of similar governance models where the private sector is encouraged to take part and where the range of green financial instruments is broadened.

The research, in a nutshell, has it that green investment is a strong candidate for being the prime mover of Libya's economic transformation. To seize this chance, Libya has to make the regulatory framework stronger, green financing instruments wider, and the sustainability principles part of the national economic strategies. All of this would help in diversifying the economy, increasing productivity, lowering the environmental risks, and putting Libya on the road to a more stable and sustainable growth path.

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