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Corporate Governance and Bank Size Effects on Funding-Based Liquidity Through Operational Efficiency in Banks, 2021–2025

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ABSTRACT

Banking liquidity is essential for financial stability, yet the role of corporate governance and operational efficiency in explaining funding-based liquidity remains insufficiently understood. This study examined the effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size on Funding-Based Liquidity, with Operational Efficiency as a mediating variable. A quantitative explanatory approach was employed using secondary data from annual reports and audited financial statements of 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025, yielding 200 balanced bank-year observations. Panel regression was estimated using a one-way Fixed Effect Model with Driscoll-Kraay standard errors (maxlag = 1) for both the mediator and outcome equations. Mediation was tested using bank-level bootstrap resampling with 5,000 replications. The results showed that the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size did not significantly affect Operational Efficiency. In the Funding-Based Liquidity equation, the Independent Commissioner Proportion had a positive and significant effect ($p < 0.001$), whereas the Audit Committee Proportion and Bank Size were not significant. Operational Efficiency had a negative and significant effect on Funding-Based Liquidity ($p = 0.0066$). None of the indirect effects through Operational Efficiency was significant because the bootstrap confidence intervals included zero. Thus, only H4 and H7 were supported, while H1–H3, H5–H6, and H8–H10 were not supported. The findings indicate that Independent Commissioners are more directly associated with funding-based liquidity, while operational efficiency is significantly related to liquidity but does not function as a mediating mechanism.

1. Introduction

The banking industry plays a strategic role in the economy by performing an intermediation function that involves collecting public funds and channeling them into credit. This function requires banks to maintain a balance between credit expansion, funding availability, risk management, and effective resource utilization. Banks transform relatively liquid liabilities, such as deposits, into relatively less liquid assets in the form of loans. Therefore, the effectiveness of financial intermediation depends not only on a bank's ability to distribute credit but also on its capacity to maintain funding sources and manage operational activities efficiently. This issue became particularly relevant during 2021–2025, a period characterized by post-COVID-19 economic recovery, rapid banking digitalization, changing customer behavior, and adjustments in banks' business and operational strategies. Digital transformation can expand service coverage and improve efficiency, but it also requires technological investment, stronger internal controls, and enhanced risk management capabilities. These changing conditions may generate differences in intermediation strategies, funding structures, operational costs, and resource management across banks.

One important aspect of banking intermediation is funding-based liquidity. In this study, liquidity is specifically defined as funding-based liquidity and measured using the Loan to Funding Ratio (LFR). Unlike the Loan to Deposit Ratio (LDR), which primarily considers third-party funds, LFR incorporates a broader funding structure

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by including securities issued by banks. Thus, LFR provides a measure of how banks manage credit expansion in relation to their available funding sources. The condition of funding-based liquidity among banks listed on the Indonesia Stock Exchange during 2021–2025 demonstrates considerable variation, indicating that banks operating within the same industry and observation period may adopt different approaches to credit and funding management.

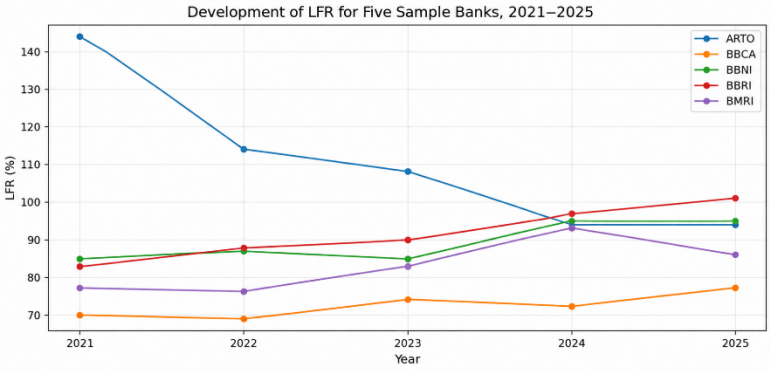


Fig. 1. Development of Funding-Based Liquidity of Five Sample Banks, 2021–2025

Source: Panel data of the study, processed by the researcher from audited financial statements.

Data from 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025, comprising 200 bank-year observations, indicate that LFR did not develop uniformly across banks. The five banks presented in Figure 1 also demonstrate different patterns. ARTO's LFR declined from approximately 146% in 2021 to 94% in 2025. BBNI remained within approximately 85%–95%, while BBRI increased from approximately 83% in 2021 to around 101% in 2025. BBCA remained at a relatively lower level of approximately 68%–77%, whereas BMRI increased to approximately 93% in 2024 before declining to around 85% in 2025. These differences suggest that variations in funding-based liquidity may be associated with differences in credit decisions, funding structures, resource management, and operational practices.

Operational efficiency is another factor potentially associated with differences in banking liquidity. In this study, operational efficiency is specifically measured by the Operating Expenses to Operating Income Ratio (BOPO). This clarification is important because the concept of corporate efficiency may have a broad scope, whereas this study limits efficiency to the bank's ability to control operating expenses relative to operating income. BOPO therefore represents the operational measure of efficiency used in this study rather than an overall measure of corporate efficiency. A higher BOPO indicates greater operating expenses relative to operating income and consequently reflects lower operational efficiency, whereas a lower BOPO indicates relatively more efficient utilization of operational resources.

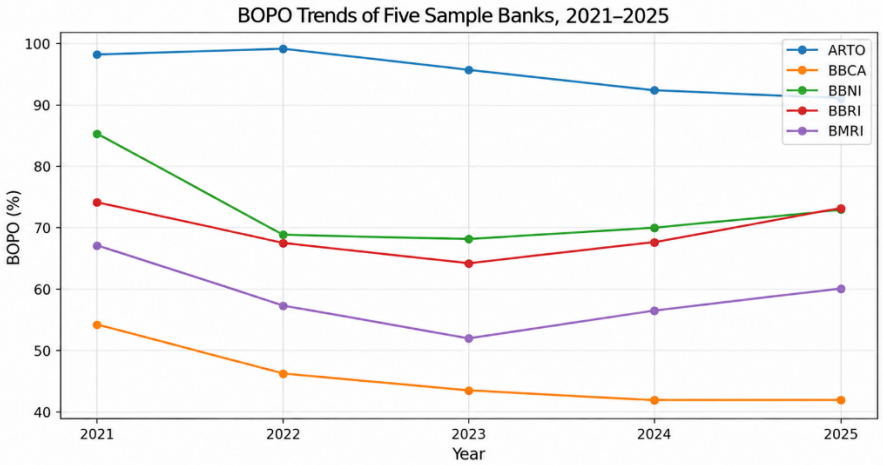


Fig. 2. Development of Operational Efficiency of Five Sample Banks, 2021–2025

Source: Panel data of the study, processed by the researcher from audited financial statements.

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The five sample banks show considerable variation in BOPO. ARTO recorded a BOPO of approximately 99% in 2021–2022 before declining to around 91% in 2025. BBCA decreased from approximately 54% in 2021 to around 42% in 2025. BMRI declined from approximately 67% in 2021 to 52% in 2023 before increasing to approximately 60% in 2025. BBNI and BBRI remained within intermediate ranges while displaying different patterns throughout the observation period. These developments indicate that differences in LFR coexist with differences in BOPO, although such coexistence cannot directly be interpreted as a causal relationship. Banks with larger assets do not necessarily exhibit the same BOPO and LFR levels. Such differences may reflect variations in credit decisions, funding structures, cost controls, technological investment, organizational complexity, and monitoring mechanisms.

Corporate governance is therefore a relevant factor for explaining variations in operational efficiency and funding-based liquidity, particularly through the monitoring mechanisms represented by the proportion of independent commissioners and the proportion of audit committee members. From the perspective of Agency Theory, the separation between ownership and management may create information asymmetry and conflicts of interest between principals and agents. In the banking industry, these issues become more complex because managerial decisions involve credit, funding, resource utilization, risk, and the interests of various parties. Monitoring mechanisms are consequently required to constrain opportunistic behavior and strengthen oversight of managerial decisions.

The proportion of independent commissioners in this study represents the independence of supervisory functions at the board level. Independent commissioners may theoretically monitor managerial decisions related to resource utilization, cost control, credit growth, risk appetite, and funding structures. This monitoring mechanism may therefore be associated with both BOPO and LFR. However, formal independence does not necessarily indicate effective supervision, meaning that the direction and strength of these relationships require empirical testing. In addition, the study includes the proportion of audit committee members as a distinct monitoring mechanism. The audit committee has a more specific oversight role concerning financial reporting quality, auditing, internal control, compliance, and resource utilization. Accordingly, the proportion of audit committee members is not treated as an identical indicator to the proportion of independent commissioners. Independent commissioners represent strategic supervisory independence at the board level, whereas the audit committee represents more technical oversight of reporting, auditing, internal control, and compliance. These differences provide a basis for examining the two monitoring mechanisms separately in relation to BOPO and LFR.

Bank size is another relevant factor. Bank size reflects the amount of resources under management. Larger banks may benefit from greater resources, broader networks, greater capacity for technological investment, and more diversified access to funding. At the same time, larger size may increase organizational complexity, coordination costs, delegation levels, and monitoring requirements. From an Agency Theory perspective, these conditions may expand managerial discretion while simultaneously increasing the need for effective monitoring. Bank size may therefore be related to LFR directly and may also be related to LFR through the bank's ability to manage operating costs, as reflected in BOPO.

The relationship among corporate governance, bank size, BOPO, and LFR raises an important question concerning the mechanism through which these relationships occur. This study positions operational efficiency, specifically measured by BOPO, as a mediating variable. The underlying logic is that monitoring mechanisms and bank characteristics may influence how resources are managed and how operating costs are controlled. The resulting level of operational efficiency may subsequently be associated with the bank's ability to manage credit and funding sources, as reflected in LFR. Thus, BOPO is positioned as a potential operational mechanism that transmits the effects of the proportion of independent commissioners, the proportion of audit committee members, and bank size on funding-based liquidity.

Previous studies concerning bank size, efficiency, and liquidity have produced inconsistent findings. Ghifar et al. (2023) found that bank size affected the cost efficiency of Islamic banks, although the findings differed according to the type

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of efficiency examined. Purwoko and Muid (2025) found that bank size and liquidity significantly affected financial performance, whereas Aisah and Nawangsari (2025) found that bank size did not significantly affect operational efficiency. These studies have predominantly used ROA, efficiency, LDR, or other liquidity measures as outcomes and have not specifically examined funding-based liquidity calculated based on a broader funding structure as the dependent variable. Previous research has also more frequently employed LDR or other liquidity measures than funding-based liquidity, leaving uncertainty regarding whether monitoring mechanisms through the proportion of independent commissioners and the proportion of audit committee members affect liquidity directly or through operational efficiency.

These inconsistencies reveal several research gaps. First, an outcome gap exists because previous studies have more frequently examined ROA, ROE, CAR, LDR, or efficiency measures as outcomes, whereas this study uses funding-based liquidity to capture the balance between credit and the funding structure. Second, a mechanism gap exists because limited studies have positioned operational efficiency measured by BOPO as a mediator between the proportion of independent commissioners, the proportion of audit committee members, bank size, and funding-based liquidity. Third, a governance gap remains because previous findings concerning governance mechanisms have been inconsistent, while the proportion of independent commissioners and the proportion of audit committee members represent different monitoring mechanisms that warrant separate examination. Fourth, a theoretical gap exists because limited research has incorporated bank size together with these monitoring mechanisms within a single Agency Theory framework to explain operational efficiency and funding-based liquidity.

Based on these gaps, the novelty of this study is contextual and integrative. The study uses funding-based liquidity as the dependent variable, integrates the proportion of independent commissioners, the proportion of audit committee members, bank size, and operational efficiency within a single model, and distinguishes independent commissioners and audit committee members as two separate monitoring mechanisms. Furthermore, BOPO is positioned as a mediator to examine whether operational efficiency transmits the effects of the three independent variables on LFR. The study uses panel data from 40 conventional commercial banks during 2021–2025, comprising 200 bank-year observations. Mediation analysis is conducted based on indirect effects and bootstrap confidence intervals, allowing the mediating role of operational efficiency to be evaluated without relying solely on changes in regression coefficients.

Accordingly, this study aims to analyze the effects of the proportion of independent commissioners, the proportion of audit committee members, and bank size on funding-based liquidity, both directly and indirectly through operational efficiency measured by BOPO, among conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025. Agency Theory serves as the grand theory for explaining the need for monitoring of managerial discretion, resource utilization, credit decisions, and funding decisions. Theoretically, this study contributes by integrating governance mechanisms, bank size, operational efficiency, and funding-based liquidity within a unified Agency Theory framework while distinguishing independent commissioners and audit committee members as separate monitoring mechanisms. Practically, the findings provide relevant information for bank management and governance bodies in evaluating the role of monitoring mechanisms and operational efficiency in managing funding-based liquidity. The study also provides empirical insights for banking stakeholders concerning credit expansion, funding structures, operational cost management, and governance arrangements during the post-pandemic period.

2. Literature Review

2.1 Conceptual and Theoretical Foundations

This study uses Agency Theory as the grand theory and primary theoretical foundation. The selection of Agency Theory is based on its ability to explain the delegation of authority, information asymmetry, conflicting interests, managerial discretion, agency costs, and the need for monitoring in bank management (Jensen & Meckling, 1976; Fama & Jensen, 1983). The discussion of corporate governance, bank size, operational efficiency, funding-based liquidity, and mediation in this section is positioned as the conceptual and operational foundation of the variables rather than as additional

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theories.

Agency Theory explains the relationship between company owners as principals and management as agents. Jensen and Meckling (1976) explain that the separation between ownership and corporate management may generate conflicts of interest and information asymmetry because management possesses greater information and control over corporate resources than the owners. In the banking industry, agency problems are more complex because managerial decisions are not only related to shareholders but also affect depositors, creditors, regulators, and financial system stability. The complexity of banking activities, leverage, and information characteristics makes monitoring an important mechanism for controlling managerial discretion.

Fama and Jensen (1983) explain that the separation of decision-making and control functions is necessary to reduce the possibility of opportunistic behavior. In the banking context, monitoring mechanisms through the Board of Commissioners and Audit Committee can be used to oversee managerial decisions concerning resource utilization, cost control, credit growth, risk management, and funding. In this study, Agency Theory is used to explain three characteristics that potentially influence banks' operational performance and funding-based liquidity: the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size. The Independent Commissioner Proportion and Audit Committee Proportion represent monitoring mechanisms, while Bank Size represents an organizational characteristic that determines the amount of resources and complexity subject to managerial discretion.

These mechanisms are subsequently linked to Operational Efficiency, measured using the BOPO ratio. BOPO represents the magnitude of operating expenses relative to operating income. In this study, a higher BOPO indicates that greater costs are required to generate operating income and therefore reflects lower operational efficiency. Conversely, a lower BOPO indicates relatively more efficient operating conditions. Accordingly, Agency Theory provides the conceptual basis for arguing that the effectiveness of monitoring and resource management may be associated with the control of operating costs reflected in BOPO and may subsequently be related to Funding-Based Liquidity proxied by the Loan to Funding Ratio (LFR).

Within the agency framework, bank size expands the resources under managerial discretion while increasing the length of delegation, coordination complexity, and monitoring difficulties. Banks with larger total assets may possess broader technological capacity, networks, products, and funding access, but such complexity may also increase managerial slack and monitoring costs. Therefore, Bank Size is not positioned as a separate theory but as an organizational characteristic that may strengthen or alter agency problems (Jensen & Meckling, 1976; de Haan & Vlahu, 2016). Empirical evidence indicates that increases in bank size do not always generate identical operational consequences. Berger and Mester (1997) show that financial institution efficiency is associated with bank characteristics, organization, technology, and the operating environment. Le et al. (2020) find that bank expansion in developing countries is not necessarily accompanied by better risk-based efficiency, while Wu and Zhao (2024), examining European banks, find different patterns of returns to scale as bank size increases across cost, revenue, and profit dimensions. These findings support the empirical examination of Bank Size in relation to Operational Efficiency and Funding-Based Liquidity without imposing an a priori direction.

Credit allocation and funding decisions fall within managerial discretion and have consequences for shareholders, depositors, creditors, and regulators. From an Agency Theory perspective, information asymmetry may prevent external parties from fully observing credit quality, funding adequacy, or the level of risk undertaken by management. Therefore, the Board of Commissioners, Audit Committee, control functions, and regulatory oversight are required to ensure that credit and funding decisions remain aligned with stakeholder interests (Jensen & Meckling, 1976; Basel Committee on Banking Supervision, 2015; de Haan & Vlahu, 2016).

In this study, liquidity is restricted to funding-based liquidity and is proxied by the Loan to Funding Ratio (LFR). Bank Indonesia Regulation Number 17/11/PBI/2015 developed the Loan to Deposit Ratio (LDR) into the Loan to Funding Ratio (LFR) by including securities issued by banks as a component of funding (Bank Indonesia, 2015). Funding-Based Liquidity indicates the intensity of

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credit relative to third-party funds and securities issued by the bank. This ratio does not replace the Liquidity Coverage Ratio, Net Stable Funding Ratio, or the overall prudential liquidity risk framework.

Changes in Funding-Based Liquidity may originate from credit growth, changes in third-party funds, or the use of securities as a source of funding. A higher Funding-Based Liquidity ratio may reflect increased credit distribution but may also indicate funding pressure when credit grows faster than funding. Acharya and Mora (2015) demonstrate the importance of banks' ability to maintain funding when facing liquidity pressure. Therefore, Funding-Based Liquidity is interpreted as the outcome of managerial decisions concerning credit and funding that are relevant to agency monitoring issues rather than as a single measure of bank health.

Bank governance consists of structures, processes, and mechanisms that direct and supervise banking activities. POJK Number 17 of 2023 emphasizes the principles of transparency, accountability, responsibility, independence, and fairness and covers the duties of the Board of Directors, Board of Commissioners, committees, control functions, risk management, and reporting integrity (Otoritas Jasa Keuangan, 2023). This study does not combine governance mechanisms into a single index but separates Independent Commissioners and the Audit Committee because they have different monitoring functions.

The Independent Commissioner is a member of the Board of Commissioners who does not have financial, managerial, share ownership, or family relationships that could affect his or her ability to act independently. Theoretically, independent parties may reduce managerial dominance, provide objective assessment, and strengthen oversight of strategy, budgets, risk appetite, credit, funding, and resource utilization. However, formal independence does not necessarily imply substantive independence because monitoring quality is also determined by competence, experience in banking, access to information, meeting frequency, and board culture (de Haan & Vlahu, 2016).

The Independent Commissioner Proportion is measured as the ratio of the number of Independent Commissioners to the total number of Board of Commissioners members:

INDCOM = Number of Independent Commissioners / Total Number of Board of Commissioners Members

The Independent Commissioner Proportion is measured on a 0–1 scale rather than as a percentage from 0–100, and this scale is consistently applied throughout the data, tables, coefficients, and interpretation of the study. A higher value indicates greater representation of independent parties but cannot be directly interpreted as more effective monitoring. Under these limitations, the Independent Commissioner Proportion is used to examine whether the structural composition of strategic oversight is associated with Operational Efficiency and Funding-Based Liquidity. From the Agency Theory perspective, Independent Commissioners may reduce agency problems by increasing the effectiveness of monitoring managerial decisions concerning resource utilization, cost control, credit strategy, risk management, and funding policies.

The Audit Committee assists the Board of Commissioners in overseeing financial reporting, internal and external audits, internal control, compliance, and follow-up of audit findings. From an Agency Theory perspective, the Audit Committee can reduce information asymmetry and enhance the credibility of information used by the Board of Commissioners for monitoring. The Basel Committee on Banking Supervision (2015) and POJK Number 17 of 2023 position committees, audit functions, control functions, and reporting integrity as important components of bank governance.

Empirical evidence indicates that Audit Committee effectiveness is not determined solely by the number of members. Nguyen (2021) finds that Audit Committee independence, meeting frequency, and financial expertise are associated with the limitation of risk-taking in conventional banks. Nguyen (2022) also shows that Audit Committee structures are associated with bank stability in ASEAN countries, although their effects depend on bank conditions and institutional quality. These findings support the relevance of the Audit Committee Proportion while highlighting the limitations of a composition-based proxy.

Consistent with the measurement used in the research data, the Audit Committee Proportion is calculated as the ratio of the number of Audit Committee members to the number of Board of

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Commissioners members:

AUDCOM = Number of Audit Committee Members / Total Number of Board of Commissioners Members

This ratio measures the relative structural intensity of the Audit Committee compared with the size of the Board of Commissioners. A value above one is possible when Audit Committee members, including independent external members, outnumber Board of Commissioners members. The Audit Committee Proportion is not a direct measure of expertise, independence, meeting frequency, or audit quality. Therefore, its results must be interpreted as the effect of the relative structural composition of the Audit Committee.

The structural ratio proxy is retained in this study while acknowledging its limitations. Theoretically, Audit Committee effectiveness is determined by independence, financial expertise, meeting frequency, audit quality, authority, and monitoring intensity (Nguyen, 2021), whereas the ratio of the number of members to the Board of Commissioners does not necessarily adequately represent these six dimensions. First, data availability constitutes a limitation. The annual reports of the sampled banks consistently disclose the number and composition of Audit Committee members but do not disclose, in a standardized and cross-verifiable manner, substantive independence assessments, individual financial expertise, meeting attendance records, or audit quality scores. Consequently, a reliable multidimensional quality index that is comparable across 40 banks during the five-year observation period cannot be constructed from the available secondary data.

Second, the structural proxy is methodologically and regulatorily consistent with the Independent Commissioner Proportion (INDCOM) used in this study and is aligned with POJK Number 17 of 2023, which positions the completeness and implementation of committee duties as elements of bank governance. Thus, the proxy is not merely a matter of convenience but is consistent with the applicable regulatory framework and approaches commonly used in previous banking governance research, allowing the findings to remain comparable. Third, the structural proxy provides an empirical starting point that can be tested before future research adopts more complex quality proxies through surveys, interviews, or primary data specifically measuring substantive independence, financial expertise, meeting frequency, and monitoring intensity. Accordingly, the Audit Committee Proportion in this study should strictly be interpreted as the effect of the committee's structural presence rather than the effect of the substantive quality of its oversight.

Bank Size reflects the scale of resources and organizational complexity (Amin, 2025). This study uses total assets because total assets encompass the economic resources managed by the bank. To reduce substantial differences in scale across banks, total assets are transformed using the natural logarithm:

SIZE = Ln (Total Assets)

The logarithmic transformation improves statistical comparability but does not eliminate the conceptual limitations of total assets. Two banks with identical asset values may differ in asset quality, business models, credit risk, technology, and efficiency. Therefore, Bank Size is treated as an organizational characteristic that may generate both economies of scale and complexity costs.

Operational Efficiency reflects a bank's ability to generate operating income while controlling expenses (Amin & Sulfati, 2024). This study uses the ratio of Operating Expenses to Operating Income. A higher BOPO indicates greater expenses required to generate operating income and therefore lower efficiency in the ratio-based interpretation (Dendawijaya, 2009; Kasmir, 2016). The measurement is:

BOPO = (Operating Expenses / Operating Income) × 100%

Operational Efficiency is not a direct measure of agency costs and is not frontier efficiency such as Data Envelopment Analysis or Stochastic Frontier Analysis. Rather, Operational Efficiency is an observable outcome of the structure of costs and revenues. Its value may increase because of waste, but it may also temporarily increase because of technology investment, network expansion, provisioning, or growth strategies. Fiordelisi et al. (2011) demonstrate a dynamic relationship between efficiency, capital, and risk, indicating that the interpretation of Operational Efficiency should consider bank and time-specific contexts.

Operational Efficiency is positioned as a mediator because monitoring through the Independent Commissioner Proportion and Audit Committee Proportion, as well as the capacity and

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complexity associated with Bank Size, are expected to first influence operational resource utilization. Changes in efficiency may subsequently influence the bank's flexibility in extending credit and managing funding. This positioning represents a conceptual mechanism to be tested rather than a relationship assumed in advance.

Funding-Based Liquidity in this study is a ratio calculated based on the funding structure by comparing total loans with third-party funds plus securities issued by the bank:

LFR = Total Loans / (Third-Party Funds + Securities Issued) × 100%

The use of Funding-Based Liquidity provides broader funding coverage than LDR. Although the formula refers to Bank Indonesia (2015), the ratio calculated based on the funding structure is not necessarily identical to the regulatory ratio published by banks because of differences in component scope, consolidation basis, and financial statement classification. Therefore, the term Funding-Based Liquidity in this study is interpreted in a limited manner as a proxy for the balance between credit and funding.

Díaz and Huang (2017) demonstrate that internal governance may be associated with liquidity creation, particularly in large banks. Galletta et al. (2021) also find that governance characteristics and risk committee complexity are associated with liquidity risk. These findings support positioning Funding-Based Liquidity as an outcome of managerial decisions that may be influenced by monitoring, size, and efficiency. Nevertheless, differences in liquidity measures and research contexts mean that the direction of the relationship remains subject to empirical testing.

Mediation explains the mechanism through which the effect of an independent variable on a dependent variable is transmitted through an intervening variable. In the research model, path a represents the effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size on Operational Efficiency, while path b represents the effect of Operational Efficiency on Funding-Based Liquidity. The indirect effect is obtained from the product of path coefficients a and b. Zhao et al., (2010) emphasize that mediation is evaluated based on the significance of the indirect effect and does not require a significant total effect. Hayes (2022) recommends bootstrap confidence intervals because the distribution of the product of coefficients is often non-normal. Therefore, Hypotheses 8 (H8), 9 (H9), and 10 (H10) are assessed using bootstrap confidence intervals, with a mediation effect considered detected when the confidence interval of the indirect effect does not cross zero.

2.2 Review of Empirical Studies

Previous empirical studies were reviewed based on articles and scholarly works attached to the research and published in 2021 or later. The selection considered their relevance to bank governance, Independent Commissioners, Audit Committees, Bank Size, Operational Efficiency, liquidity, and mediation mechanisms. The studies are compared based on their focus, methods, findings, and limitations to develop the empirical argument for the present study.

Najoan et al. (2021) examined the Corporate Governance Perception Index score in relation to the balance between profitability and liquidity among seven banks participating in the CGPI ranking during 2014–2018. Their findings indicate a trade-off between profitability and liquidity and an effect of governance implementation on their balance. The findings support the relationship between governance and liquidity decisions, although the governance proxy was a composite score and the liquidity proxy was LDR, which differ from the Independent Commissioner Proportion, Audit Committee Proportion, and Funding-Based Liquidity used in this study.

Pramudityo and Sofie (2023) analyzed 193 banking companies listed on the Indonesia Stock Exchange during 2017–2021 and found that Independent Commissioners, Audit Committees, and institutional ownership did not significantly affect financial performance, whereas the Board of Directors had a positive and significant effect. Fauziah and Hariyanto (2024) reported different findings: institutional ownership and board composition did not significantly affect ROA, while Operational Efficiency had a negative and significant effect. These studies indicate that structural governance mechanisms do not always generate uniform effects on bank performance, making the separate examination of Independent Commissioners and Audit Committees relevant.

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Samani et al. (2025) used 280 observations from 40 banks listed on the Indonesia Stock Exchange during 2014–2020 and applied WarpPLS path analysis. Their study found that Independent Commissioners, meeting frequency, investment decisions, and liquidity had direct positive effects on bank performance. Credit quality based on efficiency also mediated the relationships between several governance mechanisms and ROE, with the path from Independent Commissioners to efficiency-based credit quality and subsequently to ROE identified as the most optimal pathway. This study supports the use of mediation mechanisms, although its mediator and outcome differ from Operational Efficiency and Funding-Based Liquidity in the present study.

Aisah and Nawangsari (2025) examined 38 banks listed on the Indonesia Stock Exchange during 2020–2024 using a Random Effect model. Simultaneously, corporate governance mechanisms, firm size, and ROA affected Operational Efficiency. Partially, however, Independent Commissioners did not significantly affect Operational Efficiency, and Bank Size was also insignificant, while ROA had a negative and significant effect. This finding directly demonstrates the inconsistency of governance and bank size effects on cost efficiency.

Ghifar et al. (2023) analyzed 14 Indonesian Islamic commercial banks during 2016–2021. Their findings show that Bank Size affected cost efficiency, while governance, liquidity, and Bank Size simultaneously did not affect cost and profit efficiency but affected management efficiency. Differences across types of efficiency indicate that the consequences of Bank Size depend on how efficiency is measured and on the banking context.

Purwoko and Muid (2025) examined banks listed on the Indonesia Stock Exchange during 2020–2023. GCG measured through self-assessment did not significantly affect ROA, whereas firm size and liquidity had significant effects. These findings indicate the importance of size and liquidity but use ROA as the outcome and therefore do not directly address the relationship between Bank Size, Operational Efficiency, and Funding-Based Liquidity.

Nyale and Firdauza (2025) found that Bank Size had a positive and significant effect on sustainability report disclosure among 25 banking companies during 2020–2023. Although the direction and outcome differ from those of the present study, the finding demonstrates that the consequences of Bank Size may vary according to the outcome examined. Therefore, the effect of Bank Size on Operational Efficiency and Funding-Based Liquidity remains an empirical question.

Fauziah and Hariyanto (2024) found that Operational Efficiency had a negative and significant effect on ROA. This finding confirms the relevance of operational efficiency to bank financial conditions but does not examine Operational Efficiency as a direct predictor of Funding-Based Liquidity. Dionosius and Kuswanto (2025) compared five digital banks and five conventional banks based on equivalent asset levels in 2023. Mann–Whitney and Wilcoxon tests showed significant performance differences; conventional banks demonstrated better efficiency and stability, whereas digital banks faced higher Operational Efficiency ratios because of technology investment. This finding indicates that Operational Efficiency is affected by business models and transformation stages and therefore cannot automatically be interpreted as waste.

Rusnidita (2021) examined efficiency, liquidity, and CAR among 26 banks listed on the Indonesia Stock Exchange. Operational efficiency had a positive and significant effect on CAR, while liquidity was not significant. The study supports the relevance of BOPO but uses a different outcome from LFR.

Arjang and Rahman (2023) examined Independent Commissioners, Audit Committees, and performance among eight banks listed on the Indonesia Stock Exchange. Independent Commissioners had a positive but insignificant effect, while the Audit Committee had a positive and significant effect on performance. This supports separating INDCOM and AUDCOM in the present study.

Suroto and Rahmayanti (2025) examined BOPO, LDR, Bank Size, and ROA among nine digital banks. Bank Size and LDR had positive effects, while BOPO had a negative effect on ROA. However, the study did not examine BOPO as a predictor of LFR. Dionosius and Kuswanto (2025) compared digital and conventional banks using CAMELS and found that digital banks had higher BOPO, whereas conventional banks were more stable and efficient. This indicates that BOPO may be influenced by business models and technological

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transformation. Siregar (2025) examined Bank Size, GCG, and sustainability report disclosure among 39 banks and found that Bank Size had a negative effect while GCG had a positive effect on disclosure. Although the outcome differs, the study demonstrates contextual effects of Bank Size and GCG.

Table 1. Mapping of Agency Theory, Variables, and Research Mechanisms

Variable/Path	Main Theoretical Foundation	Agency Mechanism	Testing Implication
Independent Commissioner Proportion → Operational Efficiency/Funding-Based Liquidity	Agency Theory	Strategic monitoring limits discretion over costs, credit, risk appetite, and funding.	Effects on Operational Efficiency and Funding-Based Liquidity are tested separately.
Audit Committee Proportion → Operational Efficiency/Funding-Based Liquidity	Agency Theory	Audit and control oversight reduces information asymmetry.	The structural effect of the Audit Committee is tested on Operational Efficiency and Funding-Based Liquidity.
Bank Size → Operational Efficiency/Funding-Based Liquidity	Agency Theory	Increased resources and complexity expand discretion and monitoring costs.	The direction of the effect is determined empirically.
Operational Efficiency → Funding-Based Liquidity	Agency Theory	Consequences of resource utilization affect flexibility in credit and funding decisions.	Operational Efficiency is tested as a predictor of Funding-Based Liquidity.
Mediation	Agency Theory	Monitoring and complexity affect BOPO, which subsequently affects LFR.	The indirect effect is tested using bootstrapping.

Source: Processed by the researcher based on the theoretical review.

2.3 Identification of the Research Gap

The synthesis of the theoretical and empirical literature reveals several research gaps. The first gap concerns the research outcome. Previous studies have predominantly used ROA, ROE, CAR, sustainability report disclosure, LDR, or efficiency measures as dependent variables. No study identified in the reviewed literature specifically uses Funding-Based Liquidity as an outcome representing the balance between credit and funding in Indonesian conventional commercial banks.

The second gap concerns the mechanism. Samani et al. (2025) incorporated efficiency-based credit quality as a mediator leading to ROE but did not examine Operational Efficiency as a mediator transmitting the effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size to Funding-Based Liquidity. Thus, the role of Operational Efficiency as an intermediate mechanism between governance, organizational scale, and funding-based liquidity remains insufficiently examined.

The third gap concerns the separation of governance mechanisms and inconsistent findings. Pramudityo and Sofie (2023) found that Independent Commissioners and Audit Committees did not significantly affect financial performance, while Fauziah and Hariyanto (2024), Purwoko and Muid (2025), and Aisah and Nawangsari (2025) also demonstrate that particular governance mechanisms do not always have significant effects. Therefore, the Independent Commissioner Proportion and Audit Committee Proportion need to be examined as separate variables so that the different functions of strategic monitoring and audit support can be identified.

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The reviewed literature from 2021–2025 generally positions Operational Efficiency, Bank Size, governance, or liquidity as determinants of ROA, ROE, CAR, efficiency, or the balance between profitability and liquidity. Direct empirical testing integrating the Independent Commissioner Proportion, Audit Committee Proportion, Bank Size, Operational Efficiency, and Funding-Based Liquidity into a single model remains limited. The present study therefore integrates these variables in a panel model involving 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025, producing 200 bank-year observations.

The contribution of the study is contextual and integrative. It employs two distinct monitoring proxies, uses Funding-Based Liquidity as the outcome, and positions Operational Efficiency as a mediator to examine three indirect effects. The study does not claim that every individual relationship is entirely novel. Rather, its contribution lies in integrating the variables and mechanisms into a single empirical framework within the context of Indonesian conventional commercial banks.

Table 2. Summary of Previous Studies and Position of the Present Study

Researcher	Focus	Main Findings	Relevance/Gap
Rusnidita (2021)	Efficiency, liquidity, and CAR; 26 banks listed on IDX	Operational efficiency had a positive and significant effect on CAR; liquidity was not significant.	Supports the relevance of BOPO, but the outcome is not LFR.
Najoan et al. (2021)	GCG, profitability, and liquidity; 7 banks	CGPI score affected the balance between profitability and liquidity.	Uses composite GCG and LDR liquidity proxies.
Arjang and Rahman (2023)	INDCOM, Audit Committee, and performance; 8 IDX banks	INDCOM had a positive but insignificant effect; Audit Committee had a positive and significant effect on performance.	Supports separating INDCOM and AUDCOM.
Ghifar et al. (2023)	Governance, SIZE, liquidity, and efficiency; 14 Islamic banks	SIZE affected cost efficiency; results differed according to the type of efficiency.	Islamic banking context and efficiency proxies differ from BOPO.
Fauziah and Hariyanto (2024)	GCG, BOPO, and ROA; IDX banks 2022–2023	Board composition was insignificant; BOPO had a negative and significant effect on ROA.	Supports the relevance of INDCOM and BOPO; outcome is not LFR.
Purwoko & Muid (2025)	GCG, SIZE, liquidity, and ROA; IDX banks	GCG was insignificant; SIZE and liquidity significantly affected ROA.	Shows different effects of governance and size.
Samani et al. (2025)	GCG, liquidity, efficiency-based credit mediator, and ROE; 40 banks	Efficiency-based credit quality mediated governance relationships with ROE.	Supports mediation but uses a different mediator and outcome.
Suroto and Rahmayanti (2025)	BOPO, LDR, SIZE, and ROA; 9 digital banks	SIZE and LDR had positive effects; BOPO had a negative effect on ROA.	Does not examine BOPO → LFR.
Aisah and Nawangsari (2025)	Governance, SIZE, and BOPO; 38 IDX banks	INDCOM and SIZE did not significantly affect BOPO.	Closest to the H1 and H3 pathways.
Dionosius and Kuswanto (2025)	CAMELS comparison of digital and conventional banks	Digital banks had higher BOPO; conventional banks were more stable and efficient.	BOPO is affected by business models and technological transformation.

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Siregar (2025)	SIZE, GCG, and sustainability report; 39 banks	SIZE had a negative effect; GCG had a positive effect on disclosure.	Different outcome but indicates contextual effects of SIZE/GCG.

Source: Processed by the researcher from previous studies.

2.4 Development of the Conceptual Framework

The conceptual framework connects Agency Theory, empirical evidence, and the research objectives. The model consists of three independent variables, namely the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size; Operational Efficiency as the mediator; and Funding-Based Liquidity as the dependent variable. The model contains seven direct paths and three indirect paths corresponding to the ten research questions and ten research objectives.

The Independent Commissioner Proportion represents an independent monitoring mechanism that may reduce agency costs arising from information asymmetry and potential managerial opportunism (Jensen & Meckling, 1976; Fama & Jensen, 1983). In this relationship, shareholders act as principals who delegate the management of bank resources to management as agents, while Independent Commissioners represent the interests of the principals by monitoring managerial resource utilization so that managerial decisions do not deviate from shareholder interests. Stronger monitoring may therefore reduce potential operational cost waste arising from opportunistic agent behavior. The Independent Commissioner Proportion represents the structural independence of strategic oversight, allowing Independent Commissioners to evaluate budgets, investments, remuneration, related-party transactions, and unproductive expenditures. Conceptually, stronger monitoring may improve cost discipline and reduce the BOPO ratio. However, Aisah and Nawangsari (2025) found that the Independent Commissioner Proportion did not significantly affect Operational Efficiency, while Samani et al. (2025) found that Independent Commissioners played a role through an efficiency-based credit mediator. These findings support testing the relationship without imposing a directional assumption.

The Audit Committee may strengthen the control function of the Board of Commissioners by reducing information asymmetry in reporting and compliance domains (Jensen & Meckling, 1976). In this relationship, the Audit Committee acts as an extension of the Board of Commissioners as a representative of the principal, providing technical oversight of how management as the agent accounts for resource utilization through financial reporting and compliance. Such monitoring may reduce opportunities for operational cost deviations caused by weak oversight. The Audit Committee Proportion represents the relative structural intensity of the Audit Committee compared with the Board of Commissioners and may conceptually promote oversight of reporting, audit, internal control, and compliance, thereby supporting more disciplined resource utilization. Pramudityo and Sofie (2023) found that the Audit Committee did not significantly affect bank performance, whereas Samani et al. (2025) showed that governance mechanisms could affect performance through an efficiency-based mediator. However, the relative number of members does not necessarily represent substantive committee quality. Therefore, the relationship between Audit Committee Proportion and Operational Efficiency remains subject to empirical testing.

From the Agency Theory perspective, Bank Size expands resources under managerial discretion while increasing organizational complexity and monitoring costs (Jensen & Meckling, 1976; de Haan & Vlahu, 2016). Consequently, its effect on Operational Efficiency may operate in different directions. Greater Bank Size increases resources managed by agents and may enlarge opportunities for managerial slack. At the same time, greater scale may strengthen the principal's capacity to promote efficiency through technology investment and process standardization. Bank Size may therefore be associated with lower BOPO through economies of scale, fixed-cost spreading, technological investment, and resource capacity, but it may also be associated with higher BOPO because of bureaucracy, coordination problems, and managerial slack. Ghifar et al. (2023) found that Bank Size affected cost efficiency in Islamic banks, whereas Aisah and Nawangsari (2025) found that Bank Size did not significantly affect Operational Efficiency among banks listed on the Indonesia Stock Exchange. Because these findings are inconsistent, the

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relationship is formulated as non-directional.

The Independent Commissioner Proportion may also affect Funding-Based Liquidity through its decision-control function (Fama & Jensen, 1983). Conceptually, this function can extend to strategic bank decisions concerning credit and funding by monitoring credit growth, risk appetite, and funding adequacy. Independent Commissioner monitoring may limit expansion that is not supported by adequate funding while also supporting more measured intermediation. Najoan et al. (2021) found that governance affected the balance between profitability and liquidity, while Samani et al. (2025) found that Independent Commissioners and liquidity were associated with bank performance. Therefore, the Independent Commissioner Proportion is expected to be associated with Funding-Based Liquidity without specifying an a priori direction.

The Audit Committee may affect Funding-Based Liquidity by reducing information asymmetry in reporting and compliance, which may indirectly influence the quality of bank credit and funding decisions. Technical oversight of financial reporting and internal control may reduce information asymmetry between management as the agent and shareholders as principals, making credit and funding decisions more accountable and aligned with liquidity considerations. The Audit Committee provides technical monitoring of financial information, internal controls, compliance, and audit findings, thereby improving information reliability and potentially supporting prudent credit and funding decisions. Pramudityo and Sofie (2023) found that the Audit Committee did not significantly affect financial performance, whereas Samani et al. (2025) showed that the Audit Committee could be connected to performance through efficiency-based credit quality. The effect of Audit Committee Proportion on Funding-Based Liquidity therefore remains an empirical question because the proxies and outcomes in those studies differ from those used in the present study.

Bank Size reflects asset capacity, reputation, networks, and access to funding but also organizational complexity. In the Agency Theory perspective, larger banks manage broader resources and funding alternatives while facing longer delegation chains, managerial discretion, and higher monitoring costs. Longer delegation chains may increase informational distance between principals and agents, making funding and liquidity decisions more difficult for shareholders and regulators to monitor directly. Purwoko and Muid (2025) found that Bank Size significantly affected bank performance, whereas Aisah and Nawangsari (2025) found that Bank Size did not significantly affect Operational Efficiency. Therefore, the effect of Bank Size on Funding-Based Liquidity is formulated without an a priori direction and is determined empirically.

Operational Efficiency reflects management's control over resource utilization and may determine the managerial flexibility available for funding-based liquidity decisions. A lower BOPO indicates that relatively fewer operating expenses are required to generate operating income, whereas a higher BOPO indicates greater relative operating costs. Within the agency framework, Operational Efficiency can reflect the extent to which agency costs related to resource utilization have been controlled by existing monitoring mechanisms. Better cost control may provide greater managerial flexibility for credit and funding decisions, whereas operational inefficiency may reduce flexibility and constrain the management of credit and funding. Najoan et al. (2021) identified a relationship between profitability and liquidity, while Fauziah and Hariyanto (2024) found that Operational Efficiency negatively affected ROA. Because direct testing of Operational Efficiency on Funding-Based Liquidity remains limited, the relationship is subject to empirical examination.

The first mediation pathway examines whether Operational Efficiency mediates the relationship between the Independent Commissioner Proportion and Funding-Based Liquidity. From the Agency Theory perspective, Independent Commissioner monitoring may first influence operational cost discipline before its consequences are transmitted to credit and funding decisions. The mediation chain therefore represents the possibility that monitoring by Independent Commissioners reduces agency costs at the operational level, reflected in Operational Efficiency, and that the resulting operational consequences subsequently influence Funding-Based Liquidity. Operational Efficiency constitutes a mediating mechanism if the product of the path from Independent Commissioner Proportion to Operational Efficiency and the path from Operational Efficiency to Funding-Based Liquidity

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produces a bootstrap confidence interval that does not cross zero.

The second mediation pathway examines whether the technical control function of the Audit Committee influences resource utilization and subsequently Funding-Based Liquidity through Operational Efficiency. The Audit Committee, as a representative of the principal, may reduce agency costs associated with operational resource utilization through financial reporting, internal control, audit, and compliance oversight. If these operational consequences are subsequently transmitted to credit and funding decisions, Operational Efficiency functions as the mediator between Audit Committee Proportion and Funding-Based Liquidity. The indirect effect is tested separately because the technical role of the Audit Committee differs from the strategic monitoring role of Independent Commissioners.

The third mediation pathway examines whether the benefits of scale or the costs of organizational complexity associated with Bank Size are transmitted through operational cost discipline before affecting Funding-Based Liquidity. In larger banks, economies of scale and organizational complexity may first be reflected in Operational Efficiency and subsequently affect the flexibility of credit and funding decisions. Operational Efficiency therefore connects organizational resource capacity and complexity with Funding-Based Liquidity.

Based on the synthesis of Agency Theory and previous empirical findings, the conceptual model is presented below.

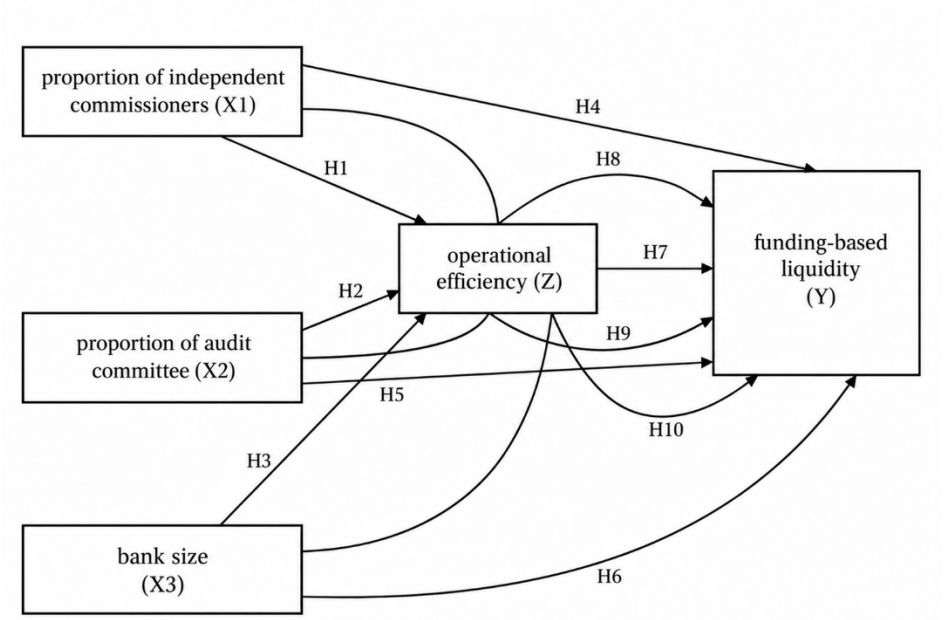


Fig. 3. Research Conceptual Framework
Source: Processed by the researcher.

Figure 3 shows that the research model consists of three independent variables, namely the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size; one mediating variable, namely Operational Efficiency; and one dependent variable, namely Funding-Based Liquidity. The paths connecting the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size to Operational Efficiency represent the first, second, and third hypotheses. These three paths examine whether governance mechanisms and bank characteristics affect the control of agency costs, as reflected in the Operating Expenses to Operating Income ratio. The paths directly connecting the three independent variables to Funding-Based Liquidity without passing through Operational Efficiency represent the fourth, fifth, and sixth hypotheses, namely the direct effects of each independent variable on Funding-Based Liquidity. Furthermore, the path connecting Operational Efficiency to Funding-Based Liquidity represents the seventh hypothesis.

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The curved paths originating from each independent variable, passing through Operational Efficiency, and ending at Funding-Based Liquidity represent indirect or mediation pathways. The indirect path from the Independent Commissioner Proportion through Operational Efficiency to Funding-Based Liquidity represents the eighth hypothesis; the path from the Audit Committee Proportion through Operational Efficiency to Funding-Based Liquidity represents the ninth hypothesis; and the path from Bank Size through Operational Efficiency to Funding-Based Liquidity represents the tenth hypothesis. The magnitude of the indirect effects in the eighth, ninth, and tenth hypotheses is obtained by multiplying the path coefficient of each independent variable to Operational Efficiency by the path coefficient of Operational Efficiency to Funding-Based Liquidity. Thus, the model enables testing of whether the effects of governance mechanisms and bank size on liquidity occur directly, indirectly through Operational Efficiency, or through both pathways. From the perspective of Agency Theory, this framework illustrates that monitoring by principals and organizational characteristics first influence the control of agency costs, after which the outcomes of such control affect credit and funding decisions made by management as agents.

2.5 Hypotheses or Research Propositions

The hypotheses are formulated as provisional answers to the ten research questions. Each hypothesis is theoretically grounded and empirically testable. The hypotheses are formulated without directional assumptions where previous empirical findings do not provide a sufficiently consistent basis for specifying the direction of the relationship.

Agency Theory positions Independent Commissioners as a monitoring mechanism over resource utilization. However, Aisah and Nawangsari (2025) found that the Independent Commissioner Proportion did not significantly affect Operational Efficiency, whereas Samani et al. (2025) found that Independent Commissioners played a role through an efficiency-based credit mediator. These differences support testing the relationship without imposing a directional assumption.

H1: The Independent Commissioner Proportion (INDCOM) affects Operational Efficiency among conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025.

The Audit Committee oversees auditing, reporting, internal control, and compliance and may therefore affect resource utilization and operating costs. Pramudityo and Sofie (2023) found that the Audit Committee did not significantly affect bank performance, whereas Samani et al. (2025) showed that committee-related governance mechanisms may operate through an efficiency-based credit mediator. The effect of the relative number of Audit Committee members on Operational Efficiency therefore requires empirical examination.

H2: The Audit Committee Proportion (AUDCOM) affects Operational Efficiency among conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025.

Agency Theory explains that increases in Bank Size expand managed resources while simultaneously increasing managerial discretion and monitoring costs. Ghifar et al. (2023) found that Bank Size affected cost efficiency, whereas Aisah and Nawangsari (2025) found that Bank Size did not significantly affect Operational Efficiency. This inconsistency supports a non-directional hypothesis.

H3: Bank Size (SIZE) affects Operational Efficiency among conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025.

Independent Commissioners monitor credit strategy, risk appetite, and funding. Najoan et al. (2021) found that governance affected the balance between profitability and liquidity, while Samani et al. (2025) showed that Independent Commissioners and liquidity were associated with bank performance. In addition, Díaz and Huang (2017) showed that internal governance is associated with liquidity creation. From the Agency Theory perspective, Independent Commissioners perform a decision-control function by monitoring the credit strategy, risk appetite, and funding policies of management as agents. Such monitoring may limit aggressive credit expansion that is not supported by adequate funding, while it may also encourage more measured intermediation. Therefore, the direction of the relationship between the Independent Commissioner Proportion and Funding-Based Liquidity cannot be determined a priori. Because the previous studies have not directly examined Funding-Based Liquidity as the outcome, the relationship requires direct empirical examination.

H4: The Independent Commissioner Proportion

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(INDCOM) affects Funding-Based Liquidity (LFR)

The Audit Committee supports the reliability of information, internal control, and compliance in credit and funding decisions. Pramudityo and Sofie (2023) found that the Audit Committee did not significantly affect bank performance, while Samani et al. (2025) showed a relationship between Audit Committee mechanisms and an efficiency-based credit mediator. Because these studies did not use Funding-Based Liquidity as the outcome, the effect of Audit Committee Proportion requires empirical examination.

H5: The Audit Committee Proportion (AUDCOM) affects Funding-Based Liquidity (LFR).

Bank Size represents asset capacity, reputation, network, and access to funding as well as organizational complexity. Purwoko and Muid (2025) found that Bank Size significantly affected financial performance, whereas Aisah and Nawangsari (2025) found that Bank Size did not significantly affect Operational Efficiency. Because previous studies use different outcomes, the effect of Bank Size on Funding-Based Liquidity is determined empirically.

H6: Bank Size (SIZE) affects Funding-Based Liquidity (LFR).

Operational Efficiency represents the relative operating expenses required to generate operating income. Fauziah and Hariyanto (2024) found that Operational Efficiency negatively affected ROA, while Najoan et al. (2021) demonstrated a trade-off between profitability and liquidity. Because direct testing of Operational Efficiency on Funding-Based Liquidity remains limited, the relationship requires empirical examination.

H7: Operational Efficiency affects Funding-Based Liquidity (LFR).

Agency Theory suggests that monitoring by Independent Commissioners may influence cost discipline, after which operational consequences may affect credit and funding decisions. Operational Efficiency is therefore expected to function as the mechanism connecting Independent Commissioner Proportion with Funding-Based Liquidity.

H8: Operational Efficiency mediates the effect of the Independent Commissioner Proportion (INDCOM) on Funding-Based Liquidity (LFR).

Audit and internal control oversight may influence resource utilization as reflected in Operational Efficiency. If the resulting operational changes are transmitted to credit and funding decisions, Operational Efficiency functions as a mediator between Audit Committee Proportion and Funding-Based Liquidity.

H9: Operational Efficiency mediates the effect of the Audit Committee Proportion (AUDCOM) on Funding-Based Liquidity (LFR).

Economies of scale or complexity costs associated with Bank Size may first be reflected in Operational Efficiency and subsequently influence credit and funding flexibility. Accordingly, the indirect effect of Bank Size on Funding-Based Liquidity through Operational Efficiency requires empirical testing.

H10: Operational Efficiency mediates the effect of Bank Size (SIZE) on Funding-Based Liquidity (LFR).

Table 3. Summary of Research Paths and Hypotheses

Hypothesis	Effect Path	Testing Method
H1	Independent Commissioner Proportion → Operational Efficiency	INDCOM coefficient in the BOPO model
H2	Audit Committee Proportion → Operational Efficiency	AUDCOM coefficient in the BOPO model
H3	Bank Size → Operational Efficiency	SIZE coefficient in the BOPO model
H4	Independent Commissioner Proportion → Funding-Based Liquidity	INDCOM coefficient in the LFR model
H5	Audit Committee Proportion → Funding-Based Liquidity	AUDCOM coefficient in the LFR model
H6	Bank Size → Funding-Based Liquidity	SIZE coefficient in the LFR model

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H7	Operational Efficiency → Funding-Based Liquidity	BOPO coefficient in the LFR model
H8	Independent Commissioner Proportion → Operational Efficiency → Funding-Based Liquidity	Bootstrap indirect effect
H9	Audit Committee Proportion → Operational Efficiency → Funding-Based Liquidity	Bootstrap indirect effect
H10	Bank Size → Operational Efficiency → Funding-Based Liquidity	Bootstrap indirect effect

Source: Processed by the researcher.

3. Research Methods

3.1 Research Design

This study employs a quantitative approach with an explanatory and observational research design. The quantitative approach is used because the relationships among variables are analyzed through numerical measurement and statistical testing. The explanatory design is employed to examine the relationships among the Independent Commissioner Proportion, Audit Committee Proportion, Bank Size, Operational Efficiency, and Funding-Based Liquidity. The study does not manipulate the variables because all data are obtained from publicly available corporate reports. The data structure takes the form of a balanced panel that combines cross-bank and intertemporal dimensions. The research panel consists of 40 banks observed over the 2021–2025 period, resulting in 200 bank-year observations. The use of panel data allows differences in bank characteristics and changes in conditions across years to be analyzed simultaneously and helps control for relatively time-invariant individual heterogeneity (Baltagi, 2021). The term "effect" in this study refers to a statistical relationship estimated through an econometric model rather than an absolute causal claim (Sekaran & Bougie, 2020; Wooldridge, 2010). The explanatory and observational design is appropriate because the study seeks to identify statistical relationships among governance mechanisms, organizational scale, operational efficiency, and funding-based liquidity based on naturally occurring archival data. The research therefore focuses on empirical estimation without intervention in the characteristics or activities of the observed banks.

3.2 Research Context and Setting

The research context comprises conventional commercial banks listed on the Indonesia Stock Exchange (IDX) that meet the predetermined sample selection criteria. The unit of analysis is the bank-year, defined as one bank observed in one year. The research period covers 2021 to 2025. The selection of conventional commercial banks is intended to maintain consistency in the institutional and financial characteristics underlying the measurement of credit, third-party funds, issued securities, BOPO, and LFR. Islamic banks are excluded because their financial and funding structures differ from those of conventional commercial banks, particularly in relation to the measurement and interpretation of credit, third-party funds, and the LFR formula employed in this study. The study is conducted through documentary research. Data are obtained from annual reports, audited annual financial statements, issuers' official websites, the Indonesia Stock Exchange, Bank Indonesia, and the Financial Services Authority (Otoritas Jasa Keuangan). The processes of data collection, processing, reconciliation, and analysis are conducted at the Graduate Program of Master of Accounting, Sekolah Tinggi Ilmu Ekonomi Makassar Bongaya. The research context is further characterized by the classification of conventional banks and digital-based banks for descriptive purposes. This classification is not used to divide the sample for hypothesis testing. Instead, hypothesis testing is performed on the complete set of bank-year observations in the final balanced panel.

2.4 Population and Sample / Research Participants

The target population comprises all commercial banks listed on the Indonesia Stock Exchange during the 2021–2025 period. The accessible population is restricted to conventional commercial banks that were continuously listed from the beginning of the observation period, published annual reports and audited annual financial statements, and provided complete data required to

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calculate all research variables, namely the Independent Commissioner Proportion (INDCOM), Audit Committee Proportion (AUDCOM), Bank Size (SIZE), Operational Efficiency (BOPO), and Funding-Based Liquidity (LFR), throughout the five-year observation period. Islamic banks and banks that were not listed from the beginning of the observation period are excluded from the accessible population to establish a comparable balanced panel.

The sample is selected using purposive sampling through two stages. The first stage assesses general eligibility, including continuity of listing during the research period, conformity with conventional banking activities, availability of annual reports and audited annual financial statements, and completeness of the required variable components. The second stage involves reconciliation and quality control to ensure that data on Independent Commissioners (INDCOM), Audit Committee (AUDCOM), Bank Size (SIZE), Operational Efficiency (BOPO), and Funding-Based Liquidity (LFR) are complete, traceable, and based on consistent reporting standards throughout 2021–2025. Conventional and digital-based banks are grouped for descriptive purposes, whereas hypothesis testing is conducted using all bank-year observations in the final panel.

Table 4. Sample Selection Criteria

No.	Sample Selection Criteria	Methodological Consideration
1	Issuers in the banking subsector were listed no later than 31 December 2021 and remained listed until the end of 2025.	Establishes the initial sampling frame and enables reports to be traced throughout the research period.
2	Continuously listed from the beginning of the 2021 observation period through 2025.	Ensures five annual observations and a balanced panel.
3	Conducted conventional banking activities; Islamic banks were excluded.	Maintains consistency in the concepts of credit, third-party funds, and the LFR formula calculated based on the funding structure.
4	Published annual reports and audited annual financial statements during 2021–2025.	Ensures that official data sources are available for each observation year.
5	Provided complete data for INDCOM, AUDCOM, SIZE, BOPO, and LFR throughout the five-year observation period.	Prevents missing values and maintains the balanced panel structure of 40 banks × 5 years.
6	All data could be reconciled and verified using consistent reporting bases, units, and calculation formulas.	Ensures comparability across banks and years and establishes an audit trail for the research.

Source: Research criteria developed by the researcher, 2026.

The sample selection process was conducted progressively by applying the criteria in Table 4 to all banking subsector issuers listed on the Indonesia Stock Exchange. Table 5 summarizes the selection stages until the final sample of 40 banks and 200 bank-year observations was obtained.

Table 5. Sample Selection Process

No.	Selection Stage	Number
1	Initial population frame of banking subsector issuers listed on the Indonesia Stock Exchange	47 banks
2	Excluded Islamic commercial banks: BANK (Bank Aladin Syariah), BRIS (Bank Syariah Indonesia), BTPS (Bank BTPN Syariah), and PNBS (Bank Panin Dubai Syariah), to maintain consistency with the LFR and BOPO formulas for conventional banks used in this study	(4 banks)
3	Excluded banks that were not continuously listed from the beginning of the 2021 period or did not meet the completeness and consistency requirements for panel data across the five research variables during 2021–2025	(3 banks)

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4	Final sample	40 banks
5	Number of observations: 40 banks × 5 years	200 bank-years

Source: Reconciliation of the population frame of banking subsector issuers on the Indonesia Stock Exchange and the research data-screening process, processed by the researcher, 2026.

Application of the criteria in Table 5 resulted in a final sample of 40 conventional commercial banks observed during 2021–2025, producing 200 bank-year observations in a balanced panel structure (40 banks × 5 years) without missing data. All observations underwent data-quality screening, including adjustment of measurement units and scales, verification of the consistency of calculation formulas for each variable, and examination of values outside reasonable ranges. Complete documentation of this process is presented in the Data Screening Appendix.

Table 6. List and Classification of Research Sample Banks

No.	Code	Full Bank Name	Bank Type
1	AGI	PT. Bank Artha Graha Tbk	National Private
2	AGRO	PT Bank Raya Indonesia Tbk	Digital
3	AGRS	PT Bank IBK Indonesia Tbk	National Private (Foreign)
4	AMAR	PT Bank Amar Indonesia Tbk	Digital
5	ARTO	PT Bank Jago Tbk	Digital
6	BABP	PT Bank MNC Internasional Tbk	National Private
7	BACA	PT Bank Capital Indonesia Tbk	National Private
8	BBCA	PT Bank Central Asia Tbk	National Private
9	BBHI	PT Allo Bank Indonesia Tbk	Digital
10	BBKP	PT Bank KB Bukopin Tbk	National Private (Foreign)
11	BBMD	PT Bank Mestika Dharma Tbk	National Private
12	BBNI	PT Bank Negara Indonesia (Persero) Tbk	State-Owned Enterprise
13	BBRI	PT Bank Rakyat Indonesia (Persero) Tbk	State-Owned Enterprise
14	BBSI	PT Krom Bank Indonesia Tbk	Digital
15	BBTN	PT Bank Tabungan Negara (Persero) Tbk	State-Owned Enterprise
16	BBYB	PT Bank Neo Commerce Tbk	Digital
17	BCIC	PT Bank JTrust Indonesia Tbk	National Private (Foreign)
18	BDMN	PT Bank Danamon Indonesia Tbk	National Private (Foreign)
19	BEKS	PT Bank Pembangunan Daerah Banten Tbk	Regional Government-Owned
20	BGTG	PT Bank Ganesha Tbk	National Private
21	BINA	PT Bank Ina Perdana Tbk	National Private
22	BJBR	PT Bank Pembangunan Daerah Jawa Barat dan Banten Tbk	Regional Government-Owned
23	BJTM	PT Bank Pembangunan Daerah Jawa Timur Tbk	Regional Government-Owned
24	BMAS	PT Bank Maspion Indonesia Tbk	National Private
25	BMRI	PT Bank Mandiri (Persero) Tbk	State-Owned Enterprise
26	BNBA	PT Bank Bumi Arta Tbk	National Private
27	BNGA	PT Bank CIMB Niaga Tbk	National Private (Foreign)
28	BNII	PT Bank Maybank Indonesia Tbk	National Private (Foreign)
29	BNLI	PT Bank Permata Tbk	National Private (Foreign)
30	BSIM	PT Bank Sinarmas Tbk	National Private
31	BTPN	PT Bank Tabungan Pensiunan Nasional Tbk	National Private (Foreign)
32	BVIC	PT Bank Victoria International Tbk	National Private
33	DNAR	PT Bank Oke Indonesia Tbk	National Private
34	MAYA	PT Bank Mayapada Internasional Tbk	National Private

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35	MCOR	PT Bank China Construction Bank Indonesia Tbk	National Private (Foreign)
36	MEGA	PT Bank Mega Tbk	National Private
37	NISP	PT Bank OCBC NISP Tbk	National Private (Foreign)
38	NOBU	PT Bank Nationalnobu Tbk	National Private
39	PANIN	PT Bank Pan Indonesia Tbk	National Private
40	SDRA	PT Bank Woori Saudara Indonesia 1906 Tbk	National Private (Foreign)

Source: Final research dataset (R_READY_DATA), processed by the researcher, 2026.

A total of 200 observations is used in the panel model. Accordingly, the main model incorporates the Independent Commissioner Proportion, Audit Committee Proportion, Bank Size, Operational Efficiency, and Funding-Based Liquidity, together with individual bank effects according to the selected model. The generalization of the findings is limited to banks that satisfy the sample selection criteria.

Detailed documentation of the data-quality screening process for all 200 observations, including verification of the panel structure, consistency of the formula for each variable, and examination of values outside reasonable ranges, is provided in the Data Screening Appendix at the end of the manuscript.

3.4 Data Sources and Data Collection

This study uses quantitative secondary data. Information on Independent Commissioners is obtained from the corporate governance section of annual reports. Total assets, operating expenses, operating income, loans, third-party funds, and issued securities are obtained from audited annual financial statements. Regulatory information and supporting definitions are obtained from publications issued by Bank Indonesia and the Financial Services Authority.

Data collection is conducted using documentation with a bank-year extraction sheet. Each observation is recorded together with the bank code, year, account name, measurement unit, reporting basis, page number, calculation formula, comparative ratio, and reconciliation notes. This documentation establishes an audit trail that allows every numerical observation to be traced back to its original source document.

The use of documentary data is consistent with the observational nature of the study because the variables are derived from publicly disclosed governance and financial information without direct intervention by the researcher. The documentation procedure also supports data traceability, consistency, and reproducibility across the 40 banks and five observation years.

3.5 Measurement of Variables and Research Instruments

The key variables are operationalized using structural governance ratios and financial ratios derived from publicly disclosed annual reports and audited financial statements. The measurement procedures are designed to maintain comparability across banks and years.

Table 7. Operational Definitions and Measurement of Variables

Variable	Position	Operational Definition	Measurement	Data Source
Independent Commissioner Proportion (INDCOM)	Independent	Percentage of independent commissioners relative to all members of the Board of Commissioners.	Number of independent commissioners ÷ total Board of Commissioners (proportion on a 0–1 scale).	Annual report.
Audit Committee Proportion (AUDCOM)	Independent	Intensity of Audit Committee oversight support for reporting, auditing, and internal control, measured by the ratio of the number of Audit Committee members to the number	Number of Audit Committee members ÷ total Board of Commissioners members (ratio; may exceed 1 when the Audit Committee involves independent parties	Annual report.

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		of Board of Commissioners members.	outside the Board of Commissioners).	
Bank Size (SIZE)	Independent	Bank scale represented by total assets.	Ln of total assets after all monetary data are standardized in million rupiah.	Audited financial statements.
Operational Efficiency (BOPO)	Mediation	Comparison of operating expenses with operating income based on the same reporting basis.	Operating expenses ÷ operating income × 100%.	Audited financial statements and reconciliation results.
Funding-Based Liquidity (LFR)	Dependent	Intensity of credit distribution relative to third-party funds and securities issued by the bank.	Total loans ÷ (third-party funds + issued securities) × 100%.	Audited financial statements; PBI No. 17/11/PBI/2015.

Source: Developed by the researcher based on source documents and the measurement basis of the variables, 2026.

The Independent Commissioner Proportion is used as a specific proxy for a monitoring mechanism and does not represent the overall quality of corporate governance. Operational Efficiency is measured through BOPO, where a higher BOPO indicates lower operational efficiency. Funding-Based Liquidity, calculated according to the funding structure used in this study, serves as a proxy for the balance between credit and funding sources rather than a comprehensive measure of prudential liquidity risk. These interpretive boundaries are applied consistently throughout the analysis and discussion.

The Audit Committee Proportion is interpreted as a structural proxy for the intensity of Audit Committee oversight. Because the ratio is calculated relative to the total number of Board of Commissioners members, it may exceed 1 when the Audit Committee includes independent members outside the Board of Commissioners. Accordingly, the measure does not directly capture substantive expertise, independence, meeting frequency, or audit quality.

Bank Size is measured using the natural logarithm of total assets. All monetary values are first standardized into million rupiah before the calculation of SIZE. BOPO is calculated by dividing operating expenses by operating income and multiplying the result by 100 percent, while LFR is calculated by dividing total loans by the sum of third-party funds and issued securities and multiplying the result by 100 percent.

3.6 Data Analysis Techniques

Data are organized in long format, with one row representing one bank-year observation. The dataset contains the bank code, year, Independent Commissioner Proportion, total assets, Bank Size, operating expenses, operating income, Operational Efficiency, total loans, third-party funds, issued securities, and Funding-Based Liquidity. Before estimation, the researcher examines completeness, consistency of measurement units, reporting bases, duplicate observations, and the accuracy of calculation formulas.

Harmonization is performed through the following procedures: (1) all monetary values are converted into million rupiah; (2) financial variables use a consistent entity basis for each bank-year; (3) Bank Size is calculated after total assets have been standardized in terms of units; (4) Funding-Based Liquidity is calculated based on the funding structure and distinguished from LDR, RIM, MIR, LCR, and NSFR; (5) Operational Efficiency is calculated using operating income and operating expenses on the same reporting basis; (6) calculated results are compared with ratios published by the banks when available; and (7) extreme values are traced to the original reports before their treatment is determined.

The primary data are analyzed in their original form after passing the verification process. Extreme observations are not removed solely because their values are high or low. As additional examination options, logarithmic transformation for positively valued variables, winsorization at the 1st and 99th

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percentiles for observations identified as outliers, and alternative estimation without highly influential observations are available as robustness procedures. The hypothesis conclusions in this study remain based on the main model using the original data, while winsorization results and HC1/HC3 robustness checks are reported in Chapter IV as supporting evidence of robustness.

Data processing and statistical analysis are performed using R. The *plm* package is used for panel-model estimation, *lmtest* and *sandwich* are used for diagnostic testing and robust standard errors, and *psych* is used for descriptive statistics. The dataset is imported using the bank code as the cross-section identifier and year as the period identifier.

The analysis stages comprise data-quality assessment, descriptive statistics, correlation analysis, multicollinearity assessment, panel-model estimation, model selection, residual diagnostics, direct hypothesis testing, indirect-effect testing, and sensitivity analysis.

Descriptive statistics include the number of observations, mean, median, minimum, maximum, standard deviation, skewness, kurtosis, and interquartile range. The summary is presented for the overall sample and, as additional information, by year and bank group. Pearson correlation is used when the distribution and data pattern are adequate, while Spearman correlation is used as a comparison when outliers or highly asymmetric distributions are present. Correlation analysis is used as an initial diagnostic and is not interpreted as evidence of a causal relationship.

Multicollinearity is assessed to determine whether high correlations exist among the independent variables in the regression models. According to Gujarati and Porter (2009), multicollinearity may cause instability in regression coefficient estimates and reduce the precision of research-result interpretation.

The Variance Inflation Factor (VIF) is used to assess multicollinearity according to the following formula:

$$VIFj = 1 / (1 - Rj^2) \quad (3.1)$$

where Rj^2 is the coefficient of determination obtained from regressing the j-th independent variable on all other independent variables in the model.

The decision criteria are as follows:

a. VIF < 10 indicates that serious multicollinearity does not occur.
b. VIF ≥ 10 indicates that serious multicollinearity occurs.

VIF testing is conducted separately for the mediator equation, in which Operational Efficiency is the dependent variable, and the outcome equation, in which Funding-Based Liquidity is the dependent variable. The results of both equations are presented and discussed in Chapter IV.

Multicollinearity is examined through the correlation matrix and centered variance inflation factor in both the mediator and outcome equations. The decision is not based solely on one threshold value but also considers coefficient stability, standard errors, and consistency of results across specifications.

The empirical model consists of a mediator equation and an outcome equation that includes the mediator. Individual bank effects are denoted by μ_i and the error terms by ε_{it}. The panel specifications considered include the Common Effect Model (CEM), Fixed Effect Model (FEM), or Random Effect Model (REM), including the presence or absence of time effects. The general equations estimated are as follows:

$$BOPO_{it} = a_0 + a_1 INDCOM_{it} + a_2 AUDCOM_{it} + a_3 SIZE_{it} + \mu_i + \varepsilon_{1it} \quad (3.2)$$

where $BOPO_{it}$ represents Operational Efficiency, measured as the ratio of Operating Expenses to Operating Income for bank i in year t, as the mediator variable; a_0 represents the intercept; a_1, a_2, and a_3 are the regression coefficients representing the effects of INDCOM, AUDCOM, and SIZE on BOPO; $INDCOM_{it}$ represents the Independent Commissioner Proportion of bank i in year t, calculated as the proportion of Independent Commissioners relative to the total Board of Commissioners; $AUDCOM_{it}$ represents the Audit Committee Proportion of bank i in year t, calculated as the proportion of Audit Committee members relative to the total Board of Commissioners; $SIZE_{it}$ represents Bank Size of bank i in year t, measured as the natural logarithm of total assets; μ_i represents the time-invariant individual cross-sectional effect of bank i; and ε_{1it} represents the error or residual component of the mediator equation for bank i in year t.

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$$LFR_{it} = \beta_0 + c_1 INDCOM_{it} + c_2 AUDCOM_{it} + c_3 SIZE_{it} + bBOPO_{it} + \mu_i + \varepsilon_{2it} \quad (3.3)$$

where LFR_{it} represents Funding-Based Liquidity (Loan to Funding Ratio) of bank i in year t as the dependent outcome variable; β_0 represents the intercept; c_1, c_2, and c_3 represent the regression coefficients for the direct effects of INDCOM, AUDCOM, and SIZE on LFR; b represents the regression coefficient for the effect of BOPO on LFR; $BOPO_{it}$ represents Operational Efficiency as the mediator variable for bank i in year t; μ_i represents the time-invariant individual cross-sectional effect of bank i; and ε_{2it} represents the error or residual component of the outcome equation for bank i in year t.

Coefficients a_1, a_2, and a_3 represent the effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size on Operational Efficiency in the mediator equation. Coefficients c_1, c_2, and c_3 represent the direct effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size on Funding-Based Liquidity in the outcome equation after Operational Efficiency is included as a mediator, whereas coefficient b represents the effect of Operational Efficiency on Funding-Based Liquidity. The indirect effect of the Independent Commissioner Proportion is calculated as $a_1 \times b$, the indirect effect of the Audit Committee Proportion is calculated as $a_2 \times b$, and the indirect effect of Bank Size is calculated as $a_3 \times b$.

The Common Effect Model, Fixed Effect Model, and Random Effect Model are considered separately for each equation through three formal tests. The Chow test (*Redundant Fixed Effects*) is used to compare the Common Effect Model with the Fixed Effect Model using the following statistic:

$$F = [(SSE_{CEM} - SSE_{FEM})/(N-1)] / [SSE_{FEM}/(NT - N - K)] \quad (3.4)$$

where *SSECEM* represents the sum of squared residuals of the Common Effect Model; *SSEFEM* represents the sum of squared residuals of the Fixed Effect Model; N represents the number of cross-sectional units or banks; T represents the number of time periods or years; and K represents the number of parameters or independent variables in the model.

The hypotheses are H0 = Common Effect Model and H1 = Fixed Effect Model. H0 is rejected and the Fixed Effect Model is selected when the *p-value* < 0.05.

The Breusch-Pagan Lagrange Multiplier test is used to compare the Common Effect Model with the Random Effect Model based on the residuals of the Common Effect Model, with the following test statistic:

$$LM = [(nT) / (2(T-1))] \times [(\Sigma i(\Sigma te_{it})^2) / (\Sigma i \Sigma te_{it}^2) - 1]^2 \quad (3.5)$$

where n represents the number of cross-sectional units or banks; T represents the number of time periods or years; and e_{it} represents the residual of the Common Effect Model (pooled OLS) for bank i in year t. The LM statistic follows a chi-square distribution with 1 degree of freedom. The hypotheses are H0 = Common Effect Model, indicating no random effect, and H1 = Random Effect Model. H0 is rejected when the *p-value* < 0.05.

The Hausman test is used to select between the Fixed Effect Model and Random Effect Model using the following test statistic:

$$W = (b - \beta)'[Var(b) - Var(\beta)]^{-1}(b - \beta) \quad (3.6)$$

where b represents the vector of coefficient estimates from the Random Effect Model and β represents the vector of coefficient estimates from the Fixed Effect Model. The W statistic follows a chi-square distribution with degrees of freedom equal to K, the number of independent variables. The hypotheses are H0 = Random Effect Model, indicating no correlation between individual effects and regressors, and H1 = Fixed Effect Model. H0 is rejected when the *p-value* < 0.05.

Time effects are also considered during the exploratory stage to control for potential common shocks affecting all banks during the 2021–2025 period.

The final model selection does not rely solely on formal test results but also considers the data structure, within-bank variation, consistency of coefficient signs, and econometric interpretability. When within-bank variation in a variable is very limited, the identification limitations associated with the Fixed Effect Model are explained in the discussion.

Model diagnostics include four tests to determine the appropriate standard-error correction before hypothesis testing. Residual normality is examined using the Jarque-Bera Test as the primary test, based on skewness and kurtosis, with the

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Shapiro-Wilk Test used as a comparison. The primary test statistic is:

$$JB = (n/6)[S^2 + (K-3)^2/4] \quad (3.7)$$

where n represents the number of observations, S represents the skewness coefficient of the residuals, and K represents the kurtosis coefficient of the residuals. The JB statistic follows a chi-square distribution with 2 degrees of freedom. The null hypothesis (H0) states that the residuals are normally distributed, with residuals considered normally distributed when the *p-value* > 0.05.

Heteroskedasticity is examined using the studentized Breusch-Pagan Test (Koenker), with the following test statistic:

$$LM = n \times R_{aux}^2 \quad (3.8)$$

where n represents the number of observations and $Raux^2$ represents the coefficient of determination from the auxiliary regression of squared residuals on all independent variables in the model. The LM statistic follows a chi-square distribution with degrees of freedom equal to k, the number of independent variables. The hypotheses are H0 = homoskedasticity, indicating constant residual variance, and H1 = heteroskedasticity. H0 is rejected when the *p-value* < 0.05.

Within-bank residual autocorrelation is examined using the panel Breusch-Godfrey/Wooldridge test, with the following test statistic:

$$BG = (n-p) \times R_{aux}^2 \quad (3.9)$$

where n represents the number of observations, p represents the order of autocorrelation being tested or the number of residual lags included, and $Raux^2$ represents the coefficient of determination from the auxiliary regression of residuals on the model's independent variables and residuals from previous periods. The BG statistic follows a chi-square distribution with p degrees of freedom. The hypotheses are H0 = no autocorrelation and H1 = autocorrelation. H0 is rejected when the *p-value* < 0.05.

Cross-section dependence among banks is examined using the Pesaran Cross-Section Dependence (CD) Test, with the following test statistic:

$$CD = \sqrt{[2T/(N(N-1))]} \times (\Sigma i \Sigma j \hat{\rho}_{ij}) \quad (3.10)$$

where T represents the number of time periods or years, N represents the number of cross-sectional units or banks, and $\hat{\rho}ij$ represents the Pearson correlation coefficient between the residuals of bank i and bank j across all periods, for $i < j$. The CD statistic follows a standard normal distribution, N(0,1), for large N. The hypotheses are H0 = no cross-section dependence, meaning that residuals across banks are uncorrelated, and H1 = cross-section dependence. H0 is rejected when the *p-value* < 0.05.

Because five annual observations within the same bank may have correlated errors, the main inference uses cluster-robust standard errors at the bank level. Given the limited number of clusters, the main results are compared with small-sample corrections or other appropriate robust procedures as robustness checks (Cameron & Miller, 2015; MacKinnon et al., 2023a, 2023b).

Direct hypotheses are tested based on coefficient values, test statistics, *p-values*, and 95% confidence intervals, with the primary significance level set at 5%. H1, H2, and H3 are tested using coefficients a_1, a_2, and a_3 in the mediator equation (3.2), respectively representing the effects of the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size on Operational Efficiency. H4, H5, H6, and H7 are tested using coefficients c_1, c_2, c_3, and b in the outcome equation (3.3), respectively representing the direct effects of the Independent Commissioner Proportion, Audit Committee Proportion, Bank Size, and Operational Efficiency on Funding-Based Liquidity. H8, H9, and H10 concerning the mediating role of Operational Efficiency are tested using the indirect effects $a_1 \times b$, $a_2 \times b$, and $a_3 \times b$. The final decision for each hypothesis considers not only statistical significance but also the direction, magnitude, consistency across models, and economic meaning of the coefficients.

Mediation effects are tested using the product-of-coefficients approach. Confidence intervals for $a \times b$ are constructed using at least 5,000 bootstrap replications with resampling at the bank level, so that all annual observations belonging to the same bank remain within the same cluster. An indirect effect is considered significant when its confidence interval does not cross zero. Statistical significance of the total effect is not treated as a mandatory condition for establishing the existence of an indirect effect (Hayes, 2022; Zhao et al., 2010).

$$IE_k = a_k \times b, \; k = 1, 2, 3 \quad (3.11)$$

where IE_k represents the indirect effect of the Independent Commissioner Proportion (k = 1),

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Audit Committee Proportion (k = 2), and Bank Size (k = 3) on Funding-Based Liquidity through Operational Efficiency; a_k represents the regression coefficient of INDCOM, AUDCOM, and SIZE on BOPO in the mediator equation (3.2); and b represents the regression coefficient of BOPO on LFR in the outcome equation (3.3).

Mediation is classified as *indirect-only mediation* when the indirect effect is significant while the direct effect is not significant; *complementary mediation* when both effects are significant and have the same direction; *competitive mediation* when both effects are significant but have opposite directions; and *no-effect nonmediation* when both the direct and indirect effects are not significant.

The mediation analysis is conducted to determine whether Operational Efficiency (BOPO) functions as an intervening variable in the relationship between the Independent Commissioner Proportion (INDCOM), Audit Committee Proportion (AUDCOM), and Bank Size (SIZE) and Funding-Based Liquidity (LFR), through indirect effects IE_1, IE_2, and IE_3 as specified in Equation 3.11.

Sensitivity analysis begins with residual-outlier detection as a continuation of the normality assessment in Section 3.6. Two approaches are used: the Z-score method, in which an observation is classified as an outlier when the absolute value of the standardized residual exceeds 3, and the IQR/boxplot method, in which an observation is classified as an outlier when it falls outside the range [Q1 − 1.5 × IQR, Q3 + 1.5 × IQR]. Observations identified as outliers are not deleted from the dataset but are treated through winsorization at the 1st and 99th percentiles for the variables generating the outlier. The model based on the original data remains the primary research result, while the model based on winsorized data is presented in Chapter IV as supporting evidence of robustness.

Sensitivity testing and robustness checks reported in this study consist of two stages. First, the estimated mediator and outcome equations are examined using HC1 robust standard-error correction (Arellano) and HC3 as comparison procedures to determine whether the conclusions regarding statistical significance are sensitive to the selected heteroskedasticity correction at the bank-cluster level.

Second, if the Cross-Section Dependence Test (Pesaran CD) indicates significant cross-section dependence in both equations, a condition that is not corrected by HC1 or HC3, the study adopts Driscoll-Kraay standard errors (Hoechle, 2007) as the primary correction for hypothesis testing because this method simultaneously addresses heteroskedasticity, autocorrelation, and cross-section dependence.

The maximum lag length (*maxlag*) is determined according to the rule ⌊T^0.25⌋ = ⌊5^0.25⌋ = 1, with *maxlag* = 2 used as an additional sensitivity test for lag length. HC1 and HC3 results are still presented as comparisons to identify which conclusions are sensitive to the selected standard-error correction method.

Additional procedures, such as logarithmic transformation and estimation without influential observations, are available as supplementary examinations, but their results do not constitute the basis for the hypothesis conclusions in this study. The conclusions are considered stronger when the direction and economic meaning remain consistent between the Driscoll-Kraay correction with *maxlag* = 1 and *maxlag* = 2.

3.7 Validity, Reliability, and Trustworthiness

Because the study employs secondary archival data rather than survey instruments, construct validity and reliability are addressed through transparent operationalization, source verification, reconciliation, and consistency checks rather than questionnaire-based validity and reliability tests.

The Independent Commissioner Proportion, Audit Committee Proportion, Bank Size, Operational Efficiency, and Funding-Based Liquidity are measured using explicitly defined formulas and publicly documented financial and governance information. Each observation is recorded with its bank code, year, account name, unit, reporting basis, source page, calculation formula, comparative ratio, and reconciliation notes. This procedure establishes an audit trail for the research data.

Quality control is conducted through verification of panel completeness, reporting-unit harmonization, formula consistency, duplicate observations, and values outside reasonable ranges. Calculated ratios are compared with published bank ratios where available. Extreme observations are traced to their original source documents before any treatment is applied, and observations are not deleted solely because their values are high or low.

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The use of 40 banks × 5 years produces a balanced panel of 200 bank-year observations. The absence of missing values in the final panel supports consistency in the longitudinal comparison, while the documented screening and reconciliation procedures strengthen the reliability and traceability of the empirical dataset.

The robustness of statistical inference is further examined through alternative standard-error corrections, including HC1, HC3, and Driscoll-Kraay procedures, as well as winsorized-data specifications where appropriate. These procedures provide additional evidence regarding the stability of the statistical conclusions without replacing the original-data model used as the primary basis for hypothesis testing.

3.8 Ethical Considerations

This study uses secondary data obtained from publicly accessible annual reports, audited annual financial statements, official issuer websites, the Indonesia Stock Exchange, Bank Indonesia, and the Financial Services Authority. Therefore, the study does not involve direct interaction with human participants, surveys, interviews, or the collection of personally identifiable information.

All data are used for academic research purposes and are attributed to their respective public sources. The documentation process is designed to preserve data traceability and academic integrity by recording the source, reporting basis, page number, formula, and reconciliation information for each extracted observation. No confidential bank information is intentionally collected or disclosed.

The study also maintains analytical integrity by retaining the original observations as the primary dataset. Outliers are not removed merely because they have extreme values, and robustness procedures are reported separately from the main model. The interpretation of statistical effects is restricted to the relationships estimated by the econometric models and does not represent an absolute causal claim.

3.9 Research Procedure

The research procedure begins with the identification of the target population of banking subsector issuers listed on the Indonesia Stock Exchange during the 2021–2025 period. The researcher then applies the purposive sampling criteria to establish the accessible population and final sample. The second stage involves collecting annual reports and audited annual financial statements from official sources. Relevant information on corporate governance and financial accounts is extracted using a bank-year documentation sheet. Each observation is recorded together with its source and supporting information to establish an audit trail. The third stage involves data reconciliation and harmonization. Monetary values are standardized into million rupiah, reporting bases are checked for consistency, and the formulas for INDCOM, AUDCOM, SIZE, BOPO, and LFR are applied consistently across all bank-year observations. The fourth stage involves data screening and quality control. The researcher verifies the balanced panel structure, checks for missing or duplicate observations, examines values outside reasonable ranges, compares calculated ratios with published ratios when available, and traces extreme values back to the source documents. The fifth stage consists of descriptive and preliminary analysis, including descriptive statistics, correlation analysis, and multicollinearity testing. The sixth stage involves estimation of the mediator and outcome panel equations, followed by formal model-selection tests involving the Common Effect Model, Fixed Effect Model, and Random Effect Model. The seventh stage consists of residual diagnostics, including normality, heteroskedasticity, within-bank autocorrelation, and cross-section dependence tests. The appropriate robust standard-error correction is then selected, with HC1 and HC3 used as comparison procedures and Driscoll-Kraay used as the primary correction when the specified cross-section-dependence condition is present.

The eighth stage involves direct hypothesis testing for H1–H7 and indirect-effect testing for H8–H10 using bootstrap procedures with at least 5,000 replications and resampling at the bank level. The final stage consists of sensitivity and robustness checks using alternative standard-error corrections and winsorized data, followed by interpretation of the statistical and economic meaning of the results.

3.10 Methodological Limitations

Several methodological limitations should be considered when interpreting the results. First, the study relies entirely on secondary data from publicly available annual reports and audited annual financial statements. Consequently, the analysis is restricted to

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information disclosed consistently by the sampled banks and cannot directly capture qualitative aspects of governance mechanisms that may not be standardized across reports. Second, the Independent Commissioner Proportion and Audit Committee Proportion represent structural proxies rather than comprehensive measures of substantive governance quality. In particular, the Audit Committee Proportion does not directly measure individual expertise, substantive independence, meeting attendance, meeting frequency, or audit quality. These limitations should be considered when interpreting the estimated relationships involving AUDCOM. Third, Funding-Based Liquidity is operationalized using the funding structure specified in this study. It therefore represents a proxy for the balance between credit distribution and funding sources and should not be interpreted as a comprehensive measure of prudential liquidity risk. In particular, it is distinguished from LDR, RIM, MIR, LCR, and NSFR. Fourth, the balanced-panel requirement restricts the generalization of the findings to conventional commercial banks that satisfy the specified listing, reporting, and data-completeness criteria. The findings therefore should not automatically be generalized to Islamic banks, unlisted banks, or institutions that do not satisfy the sample-selection criteria. Fifth, the panel consists of only five annual observations for each bank. Although the bank-level clustering and robust standard-error procedures are applied, the relatively limited number of time periods constrains the ability to capture longer-term dynamics and may affect the performance of some panel estimators. Sixth, the use of the 2021–2025 observation period means that the estimated relationships reflect the institutional, financial, and banking conditions represented by that period. The findings should therefore be interpreted within the temporal and institutional context of the sampled conventional commercial banks. Finally, the study uses econometric relationships to examine the proposed hypotheses. Accordingly, the term "effect" refers to the estimated statistical relationship within the specified model and should not be interpreted as an absolute causal relationship. The robustness procedures, including alternative standard-error corrections and winsorization, are intended to assess the stability of the findings but do not eliminate all limitations associated with observational panel data.

4. Results and Discussion

4.1 Research Results

4.1.1 Sample Description and Descriptive Statistics

The research object consists of conventional commercial banks listed on the Indonesia Stock Exchange (IDX) that met the purposive sampling criteria. The sampling process resulted in 40 conventional commercial banks observed during 2021–2025, producing 200 bank-year observations in a balanced panel data structure. The banking sector during this observation period is relevant to the research problem because banks operate under the supervision of the Financial Services Authority (Otoritas Jasa Keuangan) and Bank Indonesia, which require independent governance mechanisms. Therefore, the relationships between the Independent Commissioner Proportion (INDCOM), Audit Committee Proportion (AUDCOM), and Bank Size (SIZE) and Operational Efficiency (BOPO) and Funding-Based Liquidity (LFR) are examined within the framework of Agency Theory. Data for each bank were obtained from audited annual financial statements, annual reports, and official publications of the Indonesia Stock Exchange, Bank Indonesia, and the Financial Services Authority.

The general characteristics of the research sample follow from the sample selection process. The application of purposive sampling produced 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025, resulting in 200 bank-year observations. Examination of the panel dimension using the pdim() function in R confirmed that the data structure constitutes a balanced panel, meaning that each sampled bank has complete observations for all five years of the observation period without missing data. Therefore, no specific adjustment or estimation procedure for an unbalanced panel was required. The summary of the sample characteristics is presented in Table 8.

Table 8. General Characteristics of the Research Sample

Characteristics	Description
Number of banks (cross-section)	40 conventional commercial banks

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Observation period	2021–2025 (5 years)
Number of observations (bank-year)	200
Panel structure	Balanced panel (no missing data)
Cross-section identifier	BANK (issuer code)
Time-series identifier	YEAR (year)
Independent variables	INDCOM, AUDCOM, SIZE
Mediating variable	BOPO (Operational Efficiency)
Dependent variable	LFR (Funding-Based Liquidity)

Source: Research panel data (R_READY_DATA), processed by the researcher, 2026.

Descriptive statistics are presented to provide an overview of the characteristics of the research data before further statistical testing. The descriptive statistics for all 200 observations are presented in Table 9.

Table 9. Descriptive Statistics of Research Variables

Variable	N	Mean	Median	SD	Min	Max	Skewness	Kurtosis
SIZE	200	17,91	17,41	1,66	14,72	21,76	0,49	-0,68
BOPO	200	88,38	85,80	30,07	34,13	287,86	3,07	14,45
LFR	200	94,62	84,81	52,24	12,35	527,91	4,54	29,12
INDCOM	200	0,58	0,57	0,09	0,25	0,75	-0,03	-0,33
AUDCOM	200	0,77	0,75	0,20	0,38	1,33	0,42	-0,43

Source: R output, processed, 2026.

The mean BOPO is 88,38 with a standard deviation of 30,07. The mean LFR is 94,62, with a maximum value of 527,91, skewness of 4,54, and kurtosis of 29,11. BOPO also has relatively high skewness at 3,07. INDCOM and AUDCOM show relatively symmetrical distributions, with skewness values close to zero. These descriptive characteristics provide an initial representation of the distribution of the research variables and are subsequently examined through the preliminary diagnostic analyses.

The Pearson correlation matrix is presented in Table 10 as an initial assessment of the relationships among the research variables.

Table 10. Pearson Correlation Matrix

Variable	SIZE	BOPO	LFR	INDCOM	AUDCOM
SIZE	1,000	-0,274	-0,236	-0,268	-0,660
BOPO	-0,274	1,000	-0,128	0,093	0,096
LFR	-0,236	-0,128	1,000	0,183	0,183
INDCOM	-0,268	0,093	0,183	1,000	0,505
AUDCOM	-0,660	0,096	0,183	0,505	1,000

Source: R output, processed, 2026.

The Pearson correlation matrix indicates that the correlations among the independent variables range from weak to moderate, except for SIZE and AUDCOM, which show a relatively strong negative correlation (r = -0,660). The correlations involving BOPO and LFR with the other variables are generally weak, with absolute correlation coefficients below 0,3. The correlation matrix is used as an initial diagnostic assessment, while the statistical relationships between the variables are subsequently examined through the panel regression models.

4.1.2 Data Quality and Preliminary Analysis

Panel model selection was conducted through three stages: the Chow Test comparing the Common Effect Model (CEM) and Fixed Effect Model (FEM), the Breusch-Pagan Lagrange Multiplier (LM) Test comparing CEM and Random Effect Model

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(REM), and the Hausman Test comparing FEM and REM. The results of these tests for the mediator equation (Operational Efficiency/BOPO) and outcome equation (Funding-Based Liquidity/LFR) are presented in Table 11.

Table 11. Panel Model Selection Tests

Test	Equation 3.2 (BOPO)	Equation 3.3 (LFR)	Conclusion
Chow (F-test)	F = 6,1020; p < 0,001	F = 6,3654; p < 0,001	FEM is better than CEM
Breusch-Pagan LM	χ^2 = 93,735; p < 0,001	χ^2 = 98,433; p < 0,001	REM is better than CEM
Hausman	χ^2 = 4,0993; p = 0,251	χ^2 = 5,8685; p = 0,209	FEM and REM are consistent (p > 0,05)

Source: R output, processed, 2026.

The Chow test indicates that the *Fixed Effects Model* (FEM) is superior to the *Common Effects Model* for both equations ($p < 0.001$), indicating the presence of significant individual bank effects that cannot be ignored. The Breusch-Pagan LM test also indicates that the *Random Effects Model* (REM) is superior to the *Common Effects Model* ($p < 0.001$). The Hausman test for both equations produces *p-values* above 0.05 (0.251 and 0.209), indicating no systematic difference between the FEM and REM estimators, such that both are statistically consistent, with REM being theoretically more efficient. Nevertheless, this study selects the one-way FEM with individual bank effects based on two considerations. First, the standard Hausman test assumes homoskedastic and non-autocorrelated errors, whereas the diagnostic tests in Table 4.5 indicate that both assumptions are not satisfied; therefore, the Hausman test results should be interpreted with caution (Wooldridge, 2010). Second, FEM remains consistent even when individual bank effects are correlated with the independent variables, making FEM a more conservative choice for controlling for interbank heterogeneity that is shown to be significant by the Chow test (Baltagi, 2021). The consequence of this choice is reduced estimation efficiency, which is acknowledged as part of the study's limitations.

As a robustness check for the model selection, the research equations were also estimated using REM with Driscoll-Kraay *standard errors* (maxlag = 1). In the *outcome equation*, the Independent Commissioner Proportion remained positive and significantly associated with LFR (coefficient 68.2742; $p = 0.0046$), while BOPO remained negatively and significantly associated with LFR (coefficient −0.2672; $p = 0.0016$). In the mediator equation, no variable was significant at the 5% level, including Bank Size (coefficient −4.5492; $p = 0.0630$). Thus, the decisions for all direct hypotheses (H1–H7) do not depend on the choice between FEM and REM.

Model diagnostics were conducted to assess heteroskedasticity, within-bank autocorrelation, and cross-section dependence and to determine the appropriate correction for standard errors. The diagnostic test results are presented in Table 12.

Table 12. Model Diagnostic Tests

Test	Equation 3.2 (BOPO)	Equation 3.3 (LFR)	Conclusion
Breusch-Pagan (Heteroskedasticity)	BP = 8,5697; p = 0,036	BP = 14,826; p = 0,005	Heteroskedasticity is present
Breusch-Godfrey/Wooldridge (Autocorrelation)	χ^2 = 36,690; p < 0,001	χ^2 = 67,604; p < 0,001	Autocorrelation is present
Pesaran CD (Cross-Section Dependence)	z = 7,0702; p < 0,001	z = 22,556; p < 0,001	Cross-bank dependence is present

Source: R output, processed, 2026.

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The three diagnostic tests are statistically significant for both equations, indicating the presence of heteroskedasticity, within-bank autocorrelation, and cross-section dependence. These results provide the basis for applying Driscoll-Kraay standard errors as the principal correction in Section 4.1.4, because this approach simultaneously addresses these three sources of dependence (Hoechle, 2007).

Residual normality was examined using the Jarque-Bera Test as the primary test, based on skewness and kurtosis, and the Shapiro-Wilk Test as a comparative test. The null hypothesis (H0) states that the residuals are normally distributed, with residual normality indicated when the p-value > 0,05. The results are presented in Table 13.

Table 13. Residual Normality Tests

Test	Equation 3.2 (BOPO)	Equation 3.3 (LFR)	Conclusion
Jarque-Bera	χ^2 = 5794,2; df = 2; p < 0,001	χ^2 = 5965,8; df = 2; p < 0,001	Residuals are not normally distributed
Shapiro-Wilk	W = 0,6838; p < 0,001	W = 0,6457; p < 0,001	Residuals are not normally distributed

Source: R output, processed, 2026.

Both normality tests produce consistent results, indicating that the residuals of both the mediator and outcome equations are not normally distributed (p-value < 0,001 for all tests). This result is consistent with the descriptive statistics in Table 13, particularly the high skewness and kurtosis of BOPO and LFR.

The non-normality of residuals does not invalidate the Fixed Effect estimation because the within estimator remains consistent under large-sample asymptotic properties even when normality is not satisfied. However, the finding has implications for inference based on default standard errors. Therefore, the study employs robust standard errors, specifically Driscoll-Kraay standard errors, while the mediation effects are tested using bootstrap procedures.

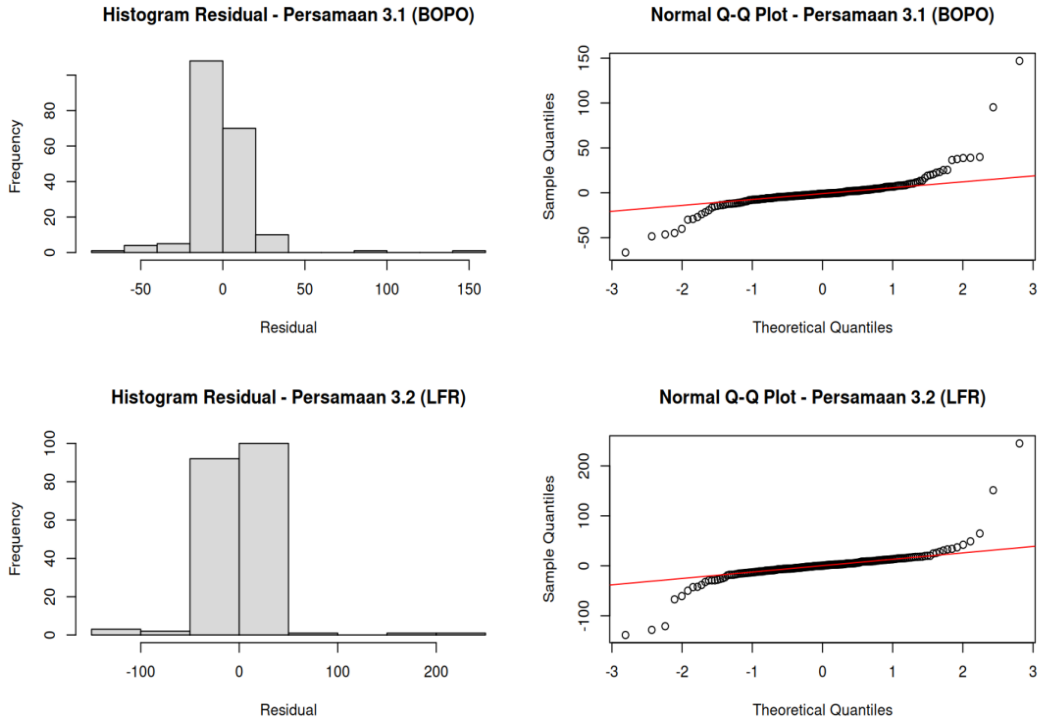


Fig. 4. Histogram and Normal Q-Q Plot of Residuals

Source: R output, processed, 2026.

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Multicollinearity was examined using the Variance Inflation Factor (VIF) in the pooled OLS model for each equation. A VIF value below 10 indicates that serious multicollinearity is not present. The results are presented in Table 14.

Table 14. Multicollinearity Test Results (VIF)

Variable	VIF Equation 3.1 (BOPO Model)	VIF Equation 3.2 (LFR Model)
INDCOM	1,3157	1,3233
AUDCOM	2,1124	2,1494
SIZE	1,7384	1,8902
BOPO	-	1,1009

Source: R output, processed, 2026.

All VIF values are substantially below 10, with the highest value being 2,1494 for AUDCOM in the outcome equation. Thus, the research models do not exhibit serious multicollinearity. The VIF results are also consistent with the Pearson correlation matrix in Table 14.

4.1.3 Main Analytical Results

The main analytical results are presented using a one-way Fixed Effect Model with bank-specific individual effects for both the mediator and outcome equations. Coefficients and significance levels are reported using Driscoll-Kraay standard errors with maxlag = 1 as the principal correction. The use of Driscoll-Kraay standard errors is based on the diagnostic results in Table 12 and the residual normality results in Table 13, which identify heteroskedasticity, autocorrelation, cross-section dependence, and non-normality. Accordingly, the inference for the main regression results is based on the corrected standard errors (Hoechle, 2007).

The mediator equation, in which Operational Efficiency (BOPO) is the dependent variable, is not statistically significant overall (F-statistic = 0,6423; df = 3;157; p = 0,5889), with R^2 of 0,0121 and Adjusted R^2 of -0,2521. The complete estimation results are presented in Table 15.

Table 15. Fixed Effect Estimation of Equation 3.2 (BOPO) with Driscoll-Kraay (maxlag = 1)

Variable	Coefficient	Std. Error (DK1)	t-value	p-value
INDCOM	27,3713	22,3940	1,2223	0,2234
AUDCOM	-3,0489	12,7698	-0,2388	0,8116
SIZE	6,1300	3,8713	1,5835	0,1153

Source: R output (coeftest with vcovSCC, maxlag = 1), processed, 2026. R^2 = 0,0121; *Adjusted* R^2 = -0,2521; *F-statistic* = 0,6423 (df = 3;157); p = 0,5889.

The estimation results for the mediator equation show that the model is not statistically significant overall, with a very low R^2 of 1.21%. None of the three independent variables (INDCOM, AUDCOM, and SIZE) has a statistically significant effect on BOPO, either under the default standard errors or the Driscoll-Kraay standard errors. This indicates that the Independent Commissioner Proportion, Audit Committee Proportion, and Bank Size do not adequately explain the variation in banks' Operational Efficiency during the 2021–2025 study period.

The outcome equation, with Funding-Based Liquidity (LFR) as the dependent variable, is statistically significant overall (F-statistic = 2.9837; df = 4;156; p = 0.0208), with an R^2 of 0.0711 and an Adjusted R^2 of −0.1850. The complete estimation results are presented in Table 16.

Table 16. Fixed Effect Estimation of Equation 3.3 (LFR) with Driscoll-Kraay (maxlag = 1)

Variable	Coefficient	Std. Error (DK1)	t-value	p-value
INDCOM	73,8957	12,1699	6,0720	0,0000 ***

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AUDCOM	-3,1126	12,2375	-0,2543	0,7996
SIZE	-38,4105	32,3797	-1,1863	0,2373
BOPO	-0,1869	0,0679	-2,7544	0,0066 **

Source: R output (coeftest with vcovSCC, maxlag = 1), processed, 2026. R^2 = 0,0711; *Adjusted* R^2 = -0,1850; *F-statistic* = 2,9837 (df = 4;156); p = 0,0208. Significance: ** p < 0,01; *** p < 0,001.

Based on the Driscoll-Kraay standard errors, INDCOM has a positive and statistically significant coefficient in the LFR equation (p < 0,001), while BOPO has a negative and statistically significant coefficient (p = 0,0066). SIZE has a negative coefficient, but its effect is not statistically significant under the Driscoll-Kraay correction (p = 0,0044). The reported inference therefore follows the Driscoll-Kraay results because this correction addresses heteroskedasticity, autocorrelation, and cross-section dependence simultaneously (Hoechle, 2007).

4.1.4 Hypothesis Testing Results / Key Findings

The hypothesis testing evaluates the relationships specified in the research model. Seven hypotheses concern direct effects, namely the effects of INDCOM, AUDCOM, and SIZE on BOPO and the effects of INDCOM, AUDCOM, SIZE, and BOPO on LFR. The hypotheses are evaluated at a five-percent significance level using the Driscoll-Kraay standard errors.

a. Direct Hypothesis Testing Results

The coefficients and p-values for each direct relationship are presented in Table 17.

Table 17. Direct Hypothesis Testing Results (H1–H7)

Hypothesis	Path	Coefficient	Std. Error (DK)	p-value	Decision
H1	INDCOM → BOPO	27,3713	22,3940	0,2234	Reject H0
H2	AUDCOM → BOPO	-3,0489	12,7698	0,8116	Reject H0
H3	SIZE → BOPO	6,1300	3,8713	0,1153	Reject H0
H4	INDCOM → LFR	73,8957	12,1699	0,0000 ***	Accept H0
H5	AUDCOM → LFR	-3,1126	12,2375	0,7996	Reject H0
H6	SIZE → LFR	-38,4105	32,3797	0,2373	Reject H0
H7	BOPO → LFR	-0,1869	0,0679	0,0066 **	Accept H0

Source: R output, processed, 2026. Significance: ** p < 0,01; *** p < 0,001. "Accept H0" indicates that the research hypothesis concerning the existence of an effect is supported by the data; "Reject H0" indicates that the research hypothesis is not supported by the data at the five-percent significance level.

The test of H1 shows that INDCOM has a coefficient of 27,3713 and a p-value of 0,2234. Since the p-value exceeds 0,05, INDCOM does not have a statistically significant effect on BOPO. Therefore, H1 is not supported by the empirical data.

The test of H2 shows that AUDCOM has a coefficient of 3,0489 and a p-value of 0,8116. Since the p-value exceeds 0,05, the effect of AUDCOM on BOPO is not statistically significant. Therefore, H2 is not supported by the empirical data.

The test of H3 shows that SIZE has a coefficient of 6,1300 and a p-value of 0,1153. Since the p-value exceeds 0,05, SIZE does not have a statistically significant effect on BOPO. Therefore, H3 is not supported by the empirical data.

The test of H4 shows that INDCOM has a coefficient of 73,8957 and a p-value < 0,001. Since the p-value is below the five-percent significance level, INDCOM has a positive and statistically significant effect on LFR. Therefore, H4 is supported by the empirical data.

The test of H5 shows that AUDCOM has a coefficient of -3,1126 and a p-value of 0,7996. Since the p-value exceeds 0,05, AUDCOM does not have a statistically significant effect on LFR. Therefore, H5 is not supported by the empirical data.

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The test of H6 shows that SIZE has a coefficient of -38,4105 and a p-value of 0,2373. Since the p-value exceeds 0,05, SIZE does not have a statistically significant effect on LFR. Therefore, H6 is not supported by the empirical data.

The test of H7 shows that BOPO has a coefficient of -0,1869 and a p-value of 0,0066. Since the p-value is below 0,05, BOPO has a negative and statistically significant effect on LFR. Therefore, H7 is supported by the empirical data.

b. Mediation Effects and Additional Findings

The mediation analysis examines whether Operational Efficiency (BOPO) mediates the relationships between INDCOM, AUDCOM, and SIZE and LFR. The indirect effects are assessed using the indirect effect estimates and 95% bootstrap confidence intervals. An indirect effect is considered statistically significant when the 95% confidence interval does not include zero. When the confidence interval includes zero, the indirect effect is considered statistically insignificant.

The mediation results for H8, H9, and H10 are presented in Table 18.

Table 18. Mediation Effect Testing Results (Bootstrap 5,000 Replications, H8–H10)

Hypothesis	Mediation Path	Indirect Effect (a×b)	95% Bootstrap CI	Decision
H8	INDCOM → BOPO → LFR	-5,1158	(-23,236 ; 6,706)	Reject H0
H9	AUDCOM → BOPO → LFR	0,5699	(-11,134 ; 12,383)	Reject H0
H10	SIZE → BOPO → LFR	-1,1457	(-8,412 ; 4,219)	Reject H0

Source: R output (bootstrap 5,000 replications, bank-cluster resampling), processed, 2026.

The indirect effect of INDCOM on LFR through BOPO is 0,5699, with a 95% confidence interval ranging from -23,236 to 6,706. Because the interval includes zero, the indirect effect is not statistically significant. Therefore, H8 is not supported by the empirical data.

The indirect effect of AUDCOM on LFR through BOPO is 0,4498, with a 95% confidence interval ranging from -11,134 to 12,383. Because the interval includes zero, the indirect effect is not statistically significant. Therefore, H9 is not supported by the empirical data.

The indirect effect of SIZE on LFR through BOPO is -1,1457, with a 95% confidence interval ranging from -8,412 to 4,219. Because the interval includes zero, the indirect effect is not statistically significant. Therefore, H10 is not supported by the empirical data.

The total effects are presented in Table 19 to provide the combined values of the direct and indirect effects. The total effect is calculated as the sum of the direct effect and the indirect effect through BOPO.

Table 19. Total Effect Analysis (Direct + Indirect)

Path	Direct Effect (c')	Indirect Effect (a×b)	Total Effect	Mediation Proportion
INDCOM → LFR	73,8957	-5,1158	68,7799	-7,44%
AUDCOM → LFR	-3,1126	0,5699	-2,5428	-22,41%
SIZE → LFR	-38,4105	-1,1457	-39,5563	2,90%

Source: Calculated by the researcher from the FEM model coefficients (Tables 15 and 16) and indirect effect estimates (Table 19), 2026.

Based on these results, the *total effect* represents the overall effect of each independent variable on LFR after accounting for both the direct and indirect effects through BOPO. However, the *total effect* is not used as the primary basis for determining the significance of the mediation effect. The mediation decisions remain based on the indirect effect estimates and bootstrap confidence intervals presented in Table 17.

c. Robustness and Sensitivity Analysis

The sensitivity and *robustness* tests were conducted to assess the consistency of the estimation results against the potential influence of extreme observations (*outliers*) and the choice of *standard error* estimation method. These tests were performed as additional analyses to ensure that the main findings were not solely driven by specific characteristics of the data or the estimation method employed.

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The sensitivity analysis began with the detection of residual *outliers* using the *Z-score* method, in which observations with an absolute standardized residual greater than 3 were identified as *outliers*. In the mediator equation (BOPO), three *outlier* observations (1.5%) were identified, namely AGRO-2021 and BBYB-2021, which had exceptionally high BOPO values, as well as BBKP-2025. In the *outcome* equation (LFR), five *outlier* observations (2.5%) were identified, three of which were from BBSI (2023–2025) and two from AMAR (2021 and 2023), representing banks with sharply fluctuating LFR values during the study period. The details of these observations are presented in Tables 20 and 21.

Table 20. Residual Outliers Using the Z-score Method (|Std. Residual| > 3) – Equation 3.2 (BOPO)

Bank – Year	Residual	Std. Residual
AGRO 2021	146,923	8,143
BBYB 2021	95,181	5,276
BBKP 2025	-66,542	-3,688

Source: R output, processed, 2026. Number of outliers: 3 of 200 observations (1,5%).

Table 21. Residual Outliers Using the Z-score Method (|Std. Residual| > 3) – Equation 3.3 (LFR)

Bank – Year	Residual	Std. Residual
BBSI 2023	244,992	8,025
AMAR 2023	151,254	4,955
AMAR 2021	-138,478	-4,536
BBSI 2025	-128,121	-4,197
BBSI 2024	-120,840	-3,958

Source: R output, processed, 2026. Number of outliers: 5 of 200 observations (2,5%).

The sensitivity and robustness analyses therefore indicate that the two statistically significant relationships identified in the principal estimation, namely the positive effect of INDCOM on LFR and the negative effect of BOPO on LFR, remain consistent under additional testing. The findings also remain consistent when potential outlier effects and alternative standard-error specifications are considered.

d. Summary of Hypothesis Testing and Key Findings

Based on all statistical tests conducted, the study evaluates ten hypotheses consisting of seven direct-effect hypotheses and three mediation hypotheses. Two hypotheses, H4 and H7, are supported by the empirical data, whereas eight hypotheses, namely H1, H2, H3, H5, H6, H8, H9, and H10, are not supported.

The overall hypothesis testing results are summarized in Table 17 and Table 18. H4 indicates a positive and statistically significant relationship between INDCOM and LFR, while H7 indicates a negative and statistically significant relationship between BOPO and LFR. H1, H2, and H3 do not show statistically significant effects on BOPO. H5 and H6 do not show statistically significant effects on LFR. H8, H9, and H10 do not show statistically significant indirect effects because their respective 95% bootstrap confidence intervals include zero.

The results presented in this subsection constitute the empirical basis for the Discussion subsection in Section 4.2, where the findings are interpreted in relation to the theoretical framework, previous empirical evidence, and the empirical context of conventional commercial banks during the 2021–2025 observation period.

4.2 Research Discussion

4.2.1 Interpretation of Key Findings

a. The Effect of the Proportion of Independent Commissioners on Operational Efficiency (H1)

The test results show that the Proportion of Independent Commissioners does not have a significant effect on Operational Efficiency. Therefore, the First Hypothesis (H1) is not supported by the research data.

The test results show that the Proportion of Independent Commissioners does not have a significant effect on Operational Efficiency, with a coefficient of 27.3713 and a p-value of 0.2234.

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Therefore, the First Hypothesis (H1) is not supported by the research data. This indicates that increases or decreases in the proportion of Independent Commissioners on the Board of Commissioners are not accompanied by meaningful changes in banks' Operational Efficiency. Banks with a higher proportion of Independent Commissioners are not proven to be more efficient in controlling operational costs than banks with a lower proportion. This is also reflected in the model's explanatory power, which accounts for only approximately 1.21% of the variation in Operational Efficiency within banks over the research period.

This finding indicates that the proportion of Independent Commissioners within the Board of Commissioners structure is not sufficient to explain variations in banks' Operational Efficiency during the research period. From the perspective of Agency Theory, the presence of Independent Commissioners essentially constitutes one of the monitoring mechanisms intended to reduce potential conflicts of interest between owners and management. Fama and Jensen (1983) position the monitoring function as an important component of mechanisms for controlling managerial decisions. However, the findings of this study indicate that the monitoring mechanism represented by the proportion of Independent Commissioners is not statistically associated with the efficiency of banks' operational resource utilization.

The insignificant effect does not necessarily indicate that Independent Commissioners do not perform their monitoring functions. One possible explanation is that the proportion of Independent Commissioners represents a structural measure, whereas Operational Efficiency is more closely related to internal operational processes, such as cost control, productivity, process digitalization, the quality of internal control systems, and resource-use efficiency. Thus, formal independence does not necessarily fully represent the intensity and quality of monitoring implemented in practice (de Haan & Vlahu, 2016).

This finding is consistent with Aisah and Nawangsari (2025), who found that the Proportion of Independent Commissioners does not have a significant effect on Operational Efficiency. Therefore, the findings provide an indication that the relationship between the structure of the Board of Commissioners and Operational Efficiency is not automatic but may depend on the quality of monitoring implementation and the internal characteristics of banks.

b. The Effect of the Proportion of the Audit Committee on Operational Efficiency (H2)

The test results show that the Proportion of the Audit Committee does not have a significant effect on Operational Efficiency. Therefore, the Second Hypothesis (H2) is not supported by the research data.

The test results show that the Proportion of the Audit Committee does not have a significant effect on Operational Efficiency, with a coefficient of −3.0489 and a p-value of 0.8116. Therefore, the Second Hypothesis (H2) is not supported by the research data. This indicates that increases or decreases in the number of Audit Committee members relative to the Board of Commissioners are not accompanied by meaningful changes in banks' Operational Efficiency. Banks with a higher proportion of Audit Committee members are not proven to be more capable of controlling operational costs than banks with a lower proportion. The p-value, which is substantially above the five-percent significance threshold, indicates that the relationship is not statistically detectable in the research data.

From the perspective of Agency Theory, the Audit Committee represents one of the governance mechanisms that assists the Board of Commissioners in monitoring financial reporting processes, internal controls, and audit activities. However, the findings indicate that the structural measure of the Audit Committee used in this study does not demonstrate a significant relationship with Operational Efficiency.

This finding needs to be understood by considering the characteristics of the variables used. The proportion or number of Audit Committee members only reflects the quantitative aspect of the committee's structure, whereas Audit Committee effectiveness is not determined solely by the number of its members. The quality of monitoring may be associated with members' financial competence, independence, experience, meeting intensity, the quality of coordination with internal and external audit functions, and the committee's ability to follow up on control findings. Therefore, the insignificant effect of the Proportion of the Audit Committee cannot directly be interpreted as evidence that the

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Audit Committee is ineffective.

This finding is consistent with Pramudityo and Sofie (2023), who found that the Audit Committee does not have a significant effect on financial performance. The distinction between structural measures and the substantive quality of monitoring may provide one explanation for why the quantitative presence of the Audit Committee does not produce a significant relationship with operational efficiency indicators.

c. The Effect of Bank Size on Operational Efficiency (H3)

The test results show that Bank Size does not have a significant effect on Operational Efficiency. Therefore, the Third Hypothesis (H3) is not supported by the research data.

The test results show that Bank Size does not have a significant effect on Operational Efficiency, with a coefficient of 6.1300 and a p-value of 0.1153. Therefore, the Third Hypothesis (H3) is not supported by the research data. This indicates that an increase in total bank assets is not accompanied by a meaningful change in Operational Efficiency. Larger banks are therefore not proven to be either more efficient or less efficient. Although the positive coefficient indicates a tendency for an increase in assets to be associated with an increase in the BOPO ratio, this tendency is not sufficiently strong to be interpreted as a significant effect.

This finding indicates that differences in bank size, as proxied by asset size, are not sufficient to significantly explain differences in Operational Efficiency within the research sample. From the perspective of Agency Theory, organizational size may generate opposing consequences. Banks with larger assets have greater resource capacity, broader networks, technological capabilities, and greater opportunities to achieve economies of scale. However, organizational growth may also increase structural complexity, lengthen decision-making processes, increase coordination costs, and intensify the potential for managerial slack (Jensen & Meckling, 1976; de Haan & Vlahu, 2016).

Accordingly, the benefits derived from organizational scale and the consequences associated with increasing complexity may occur simultaneously. This condition may cause the net effect of Bank Size on Operational Efficiency to be statistically insignificant. Therefore, the findings do not indicate that either larger or smaller banks are automatically more efficient, but rather that asset size alone is insufficient to explain the level of Operational Efficiency within the research sample.

This finding is consistent with Aisah and Nawangsari (2025), but differs from Ghifar et al. (2023) and Purwoko and Muid (2025). These differences may be related to variations in sample characteristics, observation periods, variable measurements, industry conditions, and the analytical methods employed in each study.

d. The Effect of the Proportion of Independent Commissioners on Funding-Based Liquidity (H4)

The test results show that the Proportion of Independent Commissioners has a positive and highly significant effect on Funding-Based Liquidity. In addition, the mediation test indicates that this effect does not occur significantly through Operational Efficiency. Therefore, the Fourth Hypothesis (H4) is supported by the research data.

The test results show that the Proportion of Independent Commissioners has a positive and highly significant effect on Funding-Based Liquidity, with a coefficient of 73.8957 and a p-value below 0.001. Therefore, the Fourth Hypothesis (H4) is supported by the research data. This indicates that a higher proportion of Independent Commissioners is associated with a higher Funding-Based Liquidity ratio. Economically, a ten-percentage-point increase in the proportion of Independent Commissioners is associated with an approximately 7.39-percentage-point increase in LFR, holding other variables constant. In other words, banks with stronger independent oversight tend to utilize their funding more productively through lending rather than retaining it as liquidity reserves. This result remains consistent after the treatment of extreme observations, with a coefficient of 70.3970.

This finding demonstrates a positive relationship between the Proportion of Independent Commissioners and Funding-Based Liquidity. From the perspective of Agency Theory, Independent Commissioners constitute one of the monitoring mechanisms designed to strengthen oversight of management decisions. Such oversight may conceptually be associated with banks' strategic decisions, including decisions related to credit

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growth, funding structure, risk management, and liquidity management.

The direction of this relationship should be interpreted according to the construction of the LFR ratio. A higher LFR indicates that a larger proportion of third-party funds and issued securities is allocated to loans, reflecting stronger bank intermediation while implying relatively lower liquidity reserves. Therefore, the positive relationship between the Proportion of Independent Commissioners and LFR is more appropriately interpreted as an association between independent oversight and more optimal allocation of funding to lending, rather than as an increase in liquidity reserves. The sample's average LFR of 94.62%, with a median of 84.81%, indicates that most banks remained within a reasonable level of intermediation.

The findings indicate that this relationship is more evident for liquidity outcomes than for operational efficiency. This is consistent with the H1 result, which demonstrates no significant relationship between the Proportion of Independent Commissioners and Operational Efficiency. Accordingly, based on the pattern of findings, the effect of the Proportion of Independent Commissioners on Funding-Based Liquidity is more appropriately understood as a direct relationship that does not demonstrate a mediation mechanism through Operational Efficiency.

This finding is consistent with Najoan et al. (2021) and Samani et al. (2025), who demonstrate an association between governance mechanisms and aspects of liquidity and bank performance. The differences from studies that did not identify an effect of Independent Commissioners on Operational Efficiency further indicate that governance outcomes may differ depending on the dependent variable and the characteristics of the monitoring mechanism examined.

e. The Effect of the Proportion of the Audit Committee on Funding-Based Liquidity (H5)

The test results show that the Proportion of the Audit Committee does not have a significant effect on Funding-Based Liquidity. Therefore, the Fifth Hypothesis (H5) is not supported by the research data.

The test results show that the Proportion of the Audit Committee does not have a significant effect on Funding-Based Liquidity, with a coefficient of −3.1126 and a p-value of 0.7996. Therefore, the Fifth Hypothesis (H5) is not supported by the research data. This indicates that increases or decreases in the proportion of the Audit Committee are not accompanied by meaningful changes in the ratio between loans extended and funds raised by banks. Banks with a higher proportion of Audit Committee members are not proven to be either more aggressive or more cautious in allocating their funding to loans. This differs from the Independent Commissioner finding, which is significant, suggesting that these two monitoring mechanisms may have different roles in credit and funding decisions.

This finding indicates that variations in the Proportion of the Audit Committee are insufficient to explain variations in Funding-Based Liquidity among the banks included in the research sample. From the perspective of Agency Theory, the Audit Committee performs an oversight function related to financial reporting and internal controls. However, bank liquidity decisions are also influenced by various other factors, such as funding strategies, credit growth, asset and liability maturity structures, liquidity risk management, market conditions, and bank management policies.

Therefore, the absence of a significant effect of the Proportion of the Audit Committee on Funding-Based Liquidity indicates that the structural size of the Audit Committee is insufficient to explain changes in bank liquidity. This finding also reinforces the interpretation of H2 that the quantitative aspects of the Audit Committee structure do not necessarily represent the substantive quality of monitoring.

This finding differs from Samani et al. (2025), who found an association between the Audit Committee and bank performance through efficiency-based credit quality. This difference can be understood because the study employed different mechanisms and outcomes. Thus, the effect of the Audit Committee on bank performance does not necessarily emerge across all performance or liquidity indicators.

f. The Effect of Bank Size on Funding-Based Liquidity (H6)

The test results show that Bank Size does not have a significant effect on Funding-Based Liquidity. The significance previously observed under the

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default standard errors did not persist after robust correction. Therefore, based on the corrected estimation results, the Sixth Hypothesis (H6) is not supported by the research data.

The test results show that Bank Size does not have a significant effect on Funding-Based Liquidity, with a coefficient of −38.4105 and a p-value of 0.2373. Therefore, the Sixth Hypothesis (H6) is not supported by the research data. This indicates that an increase in total bank assets is not accompanied by a meaningful change in the ratio between loans extended and funds raised. The effect initially appeared to be significant under the preliminary estimation, with a p-value of 0.0044, but this significance disappeared after correction for heteroskedasticity, autocorrelation, and cross-sectional dependence. This suggests that the relationship observed in the preliminary estimation was more likely associated with common movements among banks facing similar economic conditions rather than with the effect of bank size itself.

From the perspective of Agency Theory, bank size determines the scope of managerial authority as an agent over resources and funding choices. Larger banks have reputations and networks that facilitate the collection of third-party funds and the issuance of securities, allowing their funding base to grow more rapidly than lending. This tendency is consistent with the negative coefficient. However, broader access to funding also provides management with greater flexibility to expand lending. These two tendencies occur simultaneously and may offset one another, resulting in an insignificant net effect of bank size on Funding-Based Liquidity.

In addition, managerial discretion in determining the composition of credit and funding is not entirely unrestricted because it is constrained by regulatory oversight. Within Agency Theory, regulators may be viewed as an additional principal concerned with bank stability. The minimum reserve requirement provisions linked to the intermediation ratio (Bank Indonesia, 2015) encourage all banks, whether large or small, to maintain their credit-to-funding ratio within a certain range. This external oversight narrows the agent's discretion that would otherwise increase with bank size, so differences in size are not necessarily reflected in differences in LFR. Furthermore, the fixed-effects model relies only on within-bank changes in size over five years, which are generally insufficient to fundamentally alter the bank's agency structure.

This finding is consistent with Aisah and Nawangsari (2025), but differs from Ghifar et al. (2023) and Purwoko and Muid (2025). These differences may be attributable to differences in the dependent variables and the standard-error correction methods employed, particularly the correction for cross-sectional dependence in the present study.

g. The Effect of Operational Efficiency on Funding-Based Liquidity (H7)

The test results show that Operational Efficiency has a negative and significant effect on Funding-Based Liquidity. This relationship becomes stronger after winsorization. Therefore, the Seventh Hypothesis (H7) is supported by the research data.

The test results show that Operational Efficiency has a negative and significant effect on Funding-Based Liquidity, with a coefficient of −0.1869 and a p-value of 0.0066. Therefore, the Seventh Hypothesis (H7) is supported by the research data. Because a higher BOPO ratio indicates lower efficiency, the negative coefficient means that the less efficient a bank is, the smaller the proportion of its funding allocated to loans. Economically, a ten-percentage-point increase in BOPO is associated with an approximately 1.87-percentage-point decrease in LFR, holding other variables constant. Conversely, more efficient banks tend to perform their intermediation function more optimally. This relationship becomes stronger after the treatment of extreme observations, with a coefficient of −0.2533 and a p-value below 0.001.

This finding needs to be interpreted by considering how Operational Efficiency is measured. When Operational Efficiency is proxied by BOPO, a lower BOPO value indicates greater operational efficiency, whereas a higher BOPO value indicates relatively lower efficiency. Accordingly, the negative coefficient indicates that an increase in BOPO is associated with a decrease in Funding-Based Liquidity.

From the perspective of Agency Theory, inefficient resource utilization may reflect an increasing operational burden borne by banks. Such conditions may limit financial flexibility and management's capacity to manage resources associated with funding and liquidity. Conversely, more efficient cost management may conceptually

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provide banks with greater capacity to manage their financial resources.

Nevertheless, this statistical relationship should not be interpreted as evidence that Operational Efficiency causally increases liquidity. The findings demonstrate a negative and significant relationship based on the model employed. Causal interpretation should therefore be limited in accordance with the research design and estimation method used.

This finding has a direction consistent with Fauziah and Hariyanto (2024), who found a negative relationship between Operational Efficiency and ROA, although the outcome variable used was different. The difference in outcomes indicates that Operational Efficiency may have different implications for various dimensions of bank performance.

h. The Mediating Role of Operational Efficiency in the Effect of the Proportion of Independent Commissioners on Funding-Based Liquidity (H8)

The bootstrap test results show that Operational Efficiency does not mediate the effect of the Proportion of Independent Commissioners on Funding-Based Liquidity. Therefore, the Eighth Hypothesis (H8) is not supported by the research data.

The bootstrap test results show that the indirect effect of the Proportion of Independent Commissioners on Funding-Based Liquidity through Operational Efficiency is −5.1158, with a 95% confidence interval ranging from −23.236 to 6.706. Because the interval includes zero, Operational Efficiency does not mediate the relationship, and therefore the Eighth Hypothesis (H8) is not supported by the research data. This means that the effect of Independent Commissioners on liquidity does not occur because banks first become more efficient. Independent Commissioners have a direct effect on Funding-Based Liquidity, as demonstrated by H4, but not through improvements in Operational Efficiency. The chain of influence is interrupted at the first stage because the Proportion of Independent Commissioners does not affect Operational Efficiency, even though Operational Efficiency affects Funding-Based Liquidity.

From the perspective of Agency Theory, the research model assumes the following chain of influence: Independent Commissioners, as representatives of the principal, monitor management's use of resources so that agency costs can be reduced and operational efficiency can improve. Subsequently, a more efficient bank is expected to have greater capacity to perform its intermediation function. The findings show that the second stage of this chain is supported by H7, whereas the first stage is not supported by H1. Thus, the monitoring function of Independent Commissioners does not operate through the control of agency costs at the operational level.

This pattern can be explained through the division of functions in Agency Theory. Fama and Jensen (1983) distinguish decision-control functions performed by the board from decision-management functions performed by management. Independent Commissioners exercise control over strategic decisions, such as approval of business plans, credit policy direction, and risk limits, so their influence may be directly reflected in intermediation decisions, as indicated by H4. Conversely, cost efficiency is determined by day-to-day management decisions that are outside the board's direct operational control. Therefore, the monitoring function of Independent Commissioners may affect liquidity directly without operating through improvements in operational efficiency.

Nevertheless, the interpretation concerning this strategic decision pathway represents a theoretical explanation of the observed relationship pattern. The study does not directly test this strategic pathway; therefore, this interpretation cannot be regarded as causal evidence.

i. The Mediating Role of Operational Efficiency in the Effect of the Proportion of the Audit Committee on Funding-Based Liquidity (H9)

The bootstrap test results show that Operational Efficiency does not mediate the effect of the Proportion of the Audit Committee on Funding-Based Liquidity. Therefore, the Ninth Hypothesis (H9) is not supported by the research data.

The bootstrap test results show that the indirect effect of the Proportion of the Audit Committee on Funding-Based Liquidity through Operational Efficiency is 0.5699, with a 95% confidence interval ranging from −11.134 to 12.383.

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Because the interval includes zero, Operational Efficiency does not mediate the relationship, and therefore the Ninth Hypothesis (H9) is not supported by the research data. This means that the Audit Committee does not affect bank liquidity through improvements in operational efficiency. This finding is consistent with H2 and H5, which indicate that the Proportion of the Audit Committee does not significantly affect either Operational Efficiency or Funding-Based Liquidity. Accordingly, this study finds no evidence of an effect pathway from the Audit Committee to bank liquidity, either directly or indirectly.

From the perspective of Agency Theory, the Audit Committee plays a role in reducing information asymmetry between the principal and the agent. The research model assumes that more reliable information facilitates the detection of cost inefficiencies, thereby improving efficiency and subsequently providing greater room for banks to perform their intermediation function. The findings indicate that this chain does not operate. Reducing information asymmetry is necessary for the principal to monitor the agent, but it is not sufficient by itself. Reliable information produces changes in agent behavior only when the principal uses that information to undertake corrective actions. If Audit Committee findings are not followed by adequate corrective action, reducing information asymmetry does not necessarily result in cost discipline or changes in credit and funding decisions.

Another explanation relates to the governance structure of Indonesian banking. Banking governance regulations place Independent Commissioners among the members of the Audit Committee (Financial Services Authority, 2023), meaning that some Audit Committee oversight functions are already reflected in the role of Independent Commissioners. Consequently, adding Audit Committee members may not provide substantial additional oversight beyond the influence captured by the Proportion of Independent Commissioners. This condition also reinforces the Agency Theory interpretation that the effectiveness of a monitoring mechanism depends on the quality of its implementation, such as competence, independence, meeting frequency, and follow-up of audit findings (Nguyen, 2021), rather than merely on the number of members.

j. The Mediating Role of Operational Efficiency in the Effect of Bank Size on Funding-Based Liquidity (H10)

The bootstrap test results show that Operational Efficiency does not mediate the effect of Bank Size on Funding-Based Liquidity. Therefore, the Tenth Hypothesis (H10) is not supported by the research data.

The bootstrap test results show that the indirect effect of Bank Size on Funding-Based Liquidity through Operational Efficiency is −1.1457, with a 95% confidence interval ranging from −8.412 to 4.219. Because the interval includes zero, Operational Efficiency does not mediate the relationship, and therefore the Tenth Hypothesis (H10) is not supported by the research data. This means that an increase in bank size does not affect liquidity through changes in operational efficiency. The chain of influence is interrupted at the first stage because Bank Size does not affect Operational Efficiency, as demonstrated by H3. Together with the H6 result, this finding indicates that bank size does not have an effect pathway to liquidity, either directly or through Operational Efficiency.

From the perspective of Agency Theory, the research model assumes that bank size determines the scope of the agent's authority over resources. An increase in size may lengthen the delegation chain and increase the information distance between the principal and the agent, potentially increasing agency costs. On the other hand, greater scale provides benefits through the distribution of fixed costs and investment in technology (Jensen & Meckling, 1976). Changes in agency costs are expected to be reflected first in operational efficiency and subsequently in intermediation decisions. The findings indicate that the benefits of scale and the costs of complexity offset one another, as discussed in H3, so there is no change in efficiency that can subsequently be transmitted to liquidity.

In addition, over the five-year observation period, changes in size within the same bank were not sufficiently large to alter agency costs measurably. Thus, bank size in this study is more appropriately viewed as a relatively stable structural characteristic rather than as a driver of changes in operational efficiency or liquidity.

Overall, the H8, H9, and H10 results indicate that the chain of influence formulated in the conceptual framework—from monitoring

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mechanisms and bank characteristics to agency-cost control and subsequently to liquidity decisions—is not supported. This pattern suggests that, in Indonesian conventional commercial banks, board oversight operates through direct strategic decision-making channels, whereas operational efficiency is more strongly determined by factors outside the governance structure, such as management quality, business models, and interest-rate conditions. Thus, Agency Theory receives partial empirical support in this study, particularly for the direct relationship between Independent Commissioner oversight and liquidity and the relationship between operational efficiency and liquidity, but not for the role of operational efficiency as an intermediary mechanism.

4.2.2 Comparison with Previous Studies

The findings provide both consistencies and differences compared with previous empirical studies. The insignificant effect of the proportion of independent commissioners on operational efficiency is consistent with Aisah and Nawangsari (2025), who also found that the proportion of independent commissioners did not significantly affect operational efficiency. This similarity reinforces the indication that the relationship between board structure and operational efficiency is not automatic and may depend on the quality of monitoring implementation and the internal characteristics of banks.

The insignificant effect of the Audit Committee on operational efficiency is consistent with Pramudityo and Sofie (2023), who found that the Audit Committee did not significantly affect financial performance. Although the outcome variable differs, the finding supports the distinction between structural governance characteristics and the substantive quality of oversight. The number or proportion of Audit Committee members may not necessarily reflect their actual effectiveness in performing monitoring functions.

The insignificant effect of bank size on operational efficiency is consistent with Aisah and Nawangsari (2025), but differs from the findings of Ghifar et al. (2023) and Purwoko and Muid (2025). These differences may be associated with variations in sample characteristics, observation periods, variable measurements, industry conditions, and analytical methods.

For funding-based liquidity, the positive and significant relationship between the proportion of independent commissioners and liquidity is consistent with Najoan et al. (2021) and Samani et al. (2025), which indicate relationships between governance mechanisms and dimensions of liquidity and bank performance. The difference between this finding and studies that do not identify a significant relationship between independent commissioners and operational efficiency further indicates that governance outcomes may differ depending on the dependent variable and the specific governance mechanism being examined.

The insignificant effect of the Audit Committee on funding-based liquidity differs from Samani et al. (2025), who identified a relationship between the Audit Committee and bank performance through efficiency-based credit quality. This difference can be understood in terms of the distinct mechanisms and outcomes examined. Thus, the effect of the Audit Committee on bank performance does not necessarily emerge consistently across different performance or liquidity indicators.

The insignificant effect of bank size on funding-based liquidity is consistent with Aisah and Nawangsari (2025), but differs from Ghifar et al. (2023) and Purwoko and Muid (2025). Such differences may result from variations in samples, research periods, bank characteristics, liquidity indicators, and estimation methods.

The negative relationship between operational efficiency and funding-based liquidity also has a directional similarity with Fauziah and Hariyanto (2024), who found a negative relationship between operational efficiency and ROA, although the outcome variable examined was different. This difference in outcome indicates that operational efficiency may have different implications across dimensions of bank performance.

Overall, the comparison with previous studies demonstrates that the empirical relationship between governance, bank size, operational efficiency, and bank outcomes is context-dependent. The present findings do not uniformly confirm or contradict previous research; rather, they show that the statistical relevance of a particular governance mechanism or organizational characteristic depends

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on the specific bank outcome being examined.

4.2.3 Theoretical Contributions

The findings contribute to Agency Theory by demonstrating that governance mechanisms should not be interpreted solely based on their structural existence or quantitative proportion. Fama and Jensen (1983) emphasize the role of monitoring in controlling managerial decisions, while Jensen and Meckling (1976) explain the relevance of agency conflicts and monitoring mechanisms within organizational relationships. The present findings extend this perspective by showing that the empirical relevance of governance mechanisms may differ according to the organizational outcome under examination.

The proportion of independent commissioners was significantly associated with funding-based liquidity but not with operational efficiency. This pattern suggests that the monitoring role represented by independent commissioners may be more closely related to decisions concerning funding and liquidity than to routine operational efficiency. However, the finding should be interpreted as an empirical pattern rather than as proof of a specific causal monitoring pathway.

The insignificant relationships between the structural proportion of the Audit Committee and both operational efficiency and funding-based liquidity further contribute to the distinction between formal governance structure and substantive governance effectiveness. Consistent with the conceptual discussion of de Haan and Vlahu (2016), governance effectiveness may depend on how monitoring functions are implemented rather than merely on the existence or numerical composition of governance bodies.

The findings concerning bank size also contribute to the theoretical understanding of organizational scale within Agency Theory. Larger banks may benefit from economies of scale and greater resources, while simultaneously experiencing greater complexity, coordination costs, and potential managerial slack (Jensen & Meckling, 1976; de Haan & Vlahu, 2016). The absence of a significant relationship between bank size and both operational efficiency and funding-based liquidity suggests that these opposing mechanisms may offset one another in the observed sample.

The negative and significant relationship between BOPO and funding-based liquidity provides an additional theoretical implication by demonstrating that operational conditions are empirically associated with liquidity outcomes even when governance mechanisms do not consistently affect operational efficiency. Thus, the findings support a more differentiated application of Agency Theory in which monitoring mechanisms, organizational scale, operational efficiency, and liquidity may represent distinct dimensions of bank management rather than a single sequential mechanism.

4.2.4 Practical and Policy Implications

The findings have several practical implications for bank management. First, the significant relationship between the proportion of independent commissioners and funding-based liquidity indicates the importance of maintaining effective board-level oversight of liquidity-related decisions. The implication is not simply to increase the numerical proportion of independent commissioners, but to ensure that the monitoring function is relevant to strategic decisions concerning funding, credit growth, risk management, and liquidity.

Second, the insignificant relationships involving the Audit Committee suggest that banks should not evaluate the effectiveness of the committee solely from its structural composition. Greater attention may be directed toward the competence and independence of members, meeting intensity, coordination with internal and external audit functions, and follow-up of internal control findings. These aspects are more directly related to the substantive implementation of monitoring than numerical composition alone.

Third, the insignificant relationship between bank size and both operational efficiency and funding-based liquidity indicates that asset expansion should not automatically be regarded as an indicator of improved efficiency or liquidity management. Bank managers may therefore need to evaluate growth alongside cost control, organizational complexity, resource utilization, funding diversification, and liquidity risk management.

Fourth, the negative and significant relationship between BOPO and funding-based liquidity highlights the importance of operational cost management. Banks need to maintain

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operational efficiency because increases in BOPO are empirically associated with lower funding-based liquidity. Nevertheless, management decisions should recognize that this finding represents an empirical relationship rather than definitive evidence of a causal effect.

For policymakers and banking supervisors, the findings indicate that monitoring governance structures should not rely exclusively on formal indicators such as the proportion or number of independent commissioners and Audit Committee members. Assessment of governance effectiveness can also consider the substantive implementation of monitoring, particularly its relevance to liquidity management, internal control, risk management, and operational efficiency. In the Indonesian banking context, these implications are particularly relevant because governance mechanisms operate within a highly regulated banking environment.

4.2.5 Integration with the Research Gap

The findings address the research gap by demonstrating that the relationships among governance mechanisms, bank size, operational efficiency, and funding-based liquidity are not uniform across different bank outcomes. The literature has produced inconsistent findings concerning the effects of independent commissioners, Audit Committees, and bank size on bank performance and efficiency. The present study contributes to resolving part of this inconsistency by examining operational efficiency and funding-based liquidity simultaneously and by testing operational efficiency as a mediating mechanism.

The results show that independent commissioners have a significant direct relationship with funding-based liquidity but not with operational efficiency. The Audit Committee does not have a significant relationship with either outcome, while bank size does not significantly affect either operational efficiency or funding-based liquidity. These findings demonstrate why previous empirical results may differ when different dependent variables, samples, observation periods, and estimation methods are used.

The study further addresses the gap by testing whether operational efficiency serves as a transmission mechanism between governance mechanisms or bank size and funding-based liquidity. The absence of significant mediation for all three pathways indicates that the relationship between governance or bank characteristics and liquidity cannot be assumed to operate through operational efficiency. This finding adds empirical evidence to the literature by distinguishing direct relationships from indirect mechanisms.

Accordingly, the originality of the study lies in identifying a selective pattern of relationships within conventional commercial banks in Indonesia during 2021–2025. The statistically supported relationships are the direct relationship between the proportion of independent commissioners and funding-based liquidity and the relationship between operational efficiency and funding-based liquidity. In contrast, the mediation pathways through operational efficiency do not receive empirical support. This pattern provides a more differentiated understanding of how governance mechanisms and organizational characteristics relate to bank liquidity.

4.2.6 Acknowledgement of Study Limitations

Several limitations should be considered when interpreting these findings. First, the study uses structural proxies, namely the proportion of members, to measure the Proportion of Independent Commissioners and the Proportion of the Audit Committee. Therefore, these measures do not fully capture substantive dimensions of monitoring quality, such as members' competence, substantive independence, meeting frequency, or financial expertise. As indicated by the findings, the absence of significant relationships should therefore not be interpreted as evidence that the corresponding governance mechanisms are functionally irrelevant.

Second, the R^2 values of the mediator and outcome equations are relatively low, at 1.21% and 7.11%, respectively, based on the original data. This indicates that other factors outside the model may explain a larger proportion of the variation in Operational Efficiency and Funding-Based Liquidity.

Third, the model does not include time fixed effects or other control variables that may be relevant to bank liquidity, such as capital adequacy (CAR) and asset quality (NPL). Consequently, the possibility of omitted-variable effects cannot be completely ruled out.

Fourth, the observation period consists of only five years ($T = 5$), whereas the asymptotic properties of Driscoll-Kraay standard errors rely on a relatively long time dimension. In addition, the

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FEM was selected even though the Hausman test was not significant, resulting in relatively lower estimation efficiency compared with REM. The significance of H4 and H7 also depends on the Driscoll-Kraay correction, as both relationships were not statistically significant when bank-level cluster-robust standard errors were used.

Fifth, the model residuals are not normally distributed and exhibit heteroskedasticity, autocorrelation, and cross-section dependence. Although these issues have been addressed using Driscoll-Kraay standard errors and bootstrap procedures, the findings should nevertheless be interpreted with caution.

Sixth, the sample is limited to 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025. Therefore, the findings may not be generalizable to Islamic banks, unlisted banks, or other observation periods.

Seventh, Funding-Based Liquidity in this study is a ratio calculated based on the funding structure using the formula of Bank Indonesia (2015). It is not necessarily identical to the regulatory ratio published by banks because of differences in the scope of components and the consolidation basis.

Eighth, the term "effect" in this study refers to the statistical relationship obtained from the econometric estimation of panel data and does not constitute an absolute claim of causality (Sekaran & Bougie, 2020; Wooldridge, 2010). The findings are therefore most appropriately understood as empirical relationships identified within the specified model and research context. These limitations provide important qualifications for interpreting the findings and identify opportunities for future research to incorporate substantive governance-quality measures, additional control variables, alternative efficiency and liquidity measures, longer observation periods, and broader banking contexts.

5. Conclusion

5.1 Summary of Key Findings

The findings demonstrate that the Proportion of Independent Commissioners does not have a significant effect on Operational Efficiency. This indicates that the structural proportion of Independent Commissioners is not sufficient to explain variations in banks' Operational Efficiency. Similarly, the Proportion of the Audit Committee does not have a significant effect on Operational Efficiency, indicating that the structural size of the Audit Committee does not necessarily represent the quality of its monitoring function. Bank Size also does not significantly affect Operational Efficiency, suggesting that asset size alone is insufficient to explain variations in operational efficiency because the benefits of economies of scale may occur simultaneously with greater organizational and coordination complexity.

In contrast, the Proportion of Independent Commissioners has a positive and significant effect on Funding-Based Liquidity. This finding indicates a relationship between the monitoring mechanism of the Board of Commissioners and banks' liquidity conditions. The effect occurs directly and is not mediated by Operational Efficiency. Meanwhile, the Proportion of the Audit Committee does not have a significant effect on Funding-Based Liquidity, indicating that its structural proportion is insufficient to explain variations in banks' funding-based liquidity. Bank Size also does not significantly affect Funding-Based Liquidity, indicating that asset size alone is not sufficient to explain banks' liquidity conditions.

Operational Efficiency has a negative and significant effect on Funding-Based Liquidity. Because a lower BOPO indicates better operational efficiency, the finding indicates that increases in BOPO are associated with decreases in Funding-Based Liquidity. This relationship remains robust after winsorization, indicating that the finding is not substantially driven by identified outliers.

The mediation analysis shows that Operational Efficiency does not mediate the effects of the Proportion of Independent Commissioners, Proportion of the Audit Committee, or Bank Size on Funding-Based Liquidity. Thus, none of the three proposed mediation pathways receives empirical support. Overall, of the ten hypotheses tested, only H4 and H7 are supported by the research data. Funding-Based Liquidity among conventional commercial banks in Indonesia during 2021–2025 is therefore associated with the direct relationship between the Proportion of Independent Commissioners and liquidity and with Operational Efficiency, while the proposed mediation pathways through Operational Efficiency are not empirically supported. The findings were also examined for robustness against outliers through winsorization

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and alternative standard-error specifications.

5.2 Theoretical Contributions

This study provides several theoretical contributions to the development of Agency Theory (*Agency Theory*) in the banking context. First, the finding that the effect of Independent Commissioners on Funding-Based Liquidity is direct and not mediated by Operational Efficiency enriches the understanding of the transmission pathway of agency monitoring in banks. The *decision control* function of the Board of Commissioners (Fama & Jensen, 1983) appears to be more relevant to strategic decisions concerning credit and funding than to the control of daily operational expenses.

Second, the absence of significant effects of the Proportion of the Audit Committee across the examined pathways highlights the importance of distinguishing structural proxies, such as the ratio of the number of members, from substantive measures of monitoring quality, such as expertise, independence, and meeting frequency, in future banking governance research, consistent with the arguments of de Haan and Vlahu (2016) and Nguyen (2021).

Third, the absence of significant effects of Bank Size across the examined pathways reinforces the view that Bank Size operates as an organizational characteristic shaped by two opposing forces, namely the benefits of scale and the costs of organizational complexity, rather than as a single-directional determinant. Therefore, Bank Size should be modeled carefully within an agency framework.

Fourth, this study reinforces the methodology of bootstrap-based mediation analysis and the significance of the *indirect effect* (Zhao et al., 2010; Hayes, 2022) as an approach that does not depend on the significance of the *total effect* or the assumption of normally distributed residuals. This approach is therefore appropriate for financial panel data that commonly exhibit non-normal residuals.

5.3 Practical and Policy Implications

The findings provide several practical and policy implications for banking management and regulatory stakeholders. First, bank management should strengthen the monitoring role of Independent Commissioners in strategic decisions related to funding and liquidity. The empirical relationship identified between the Proportion of Independent Commissioners and Funding-Based Liquidity indicates the relevance of board-level oversight in this area. Second, operational cost management should receive continued attention because Operational Efficiency, as measured by BOPO, has a significant relationship with Funding-Based Liquidity. Maintaining operational efficiency may therefore form part of banks' efforts to preserve their funding-based liquidity and intermediation capacity. Third, the insignificant effect of the Proportion of the Audit Committee indicates that the effectiveness of monitoring should not be assessed solely on the basis of the number or proportion of committee members. Greater attention should be given to substantive dimensions such as members' competence, independence, experience, meeting frequency, financial expertise, coordination with audit functions, and follow-up of audit findings. Fourth, the insignificant relationship between Bank Size and both Operational Efficiency and Funding-Based Liquidity indicates that asset expansion should not automatically be regarded as an indicator of improved efficiency or liquidity. Bank management should therefore consider asset growth together with operational cost control, organizational complexity, resource utilization, funding structure, and liquidity management. For policymakers and regulators, particularly the Financial Services Authority (Otoritas Jasa Keuangan), the findings provide support for continued efforts to strengthen the substantive quality of banking governance rather than focusing exclusively on structural compliance. In particular, the quality and effectiveness of Audit Committee oversight warrant attention because the structural ratio of members did not demonstrate a significant effect on either operational efficiency or liquidity during the research period. The study also provides policy and methodological contributions. From a policy perspective, the findings provide input regarding the importance of assessing the substantive quality of governance mechanisms, particularly the Audit Committee, rather than merely their structural completeness. Methodologically, the study contributes through the application of a comprehensive set of robustness procedures, including diagnostic testing, normality testing, outlier detection, winsorization, and comparisons of standard-error specifications, as a relevant practice in the analysis of financial panel data whose residuals do not satisfy conventional assumptions.

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5.4 Limitations of the Study

Several limitations should be considered when interpreting these findings. First, the study uses structural proxies, namely the proportion of members, to measure the Proportion of Independent Commissioners and the Proportion of the Audit Committee. Therefore, these measures do not fully capture substantive dimensions of monitoring quality, such as members' competence, substantive independence, meeting frequency, or financial expertise. As indicated by the findings, the absence of significant relationships should therefore not be interpreted as evidence that the corresponding governance mechanisms are functionally irrelevant. Second, the R^2 values of the mediator and outcome equations are relatively low, at 1.21% and 7.11%, respectively, based on the original data. This indicates that other factors outside the model may explain a larger proportion of the variation in Operational Efficiency and Funding-Based Liquidity. Third, the model does not include time fixed effects or other control variables that may be relevant to bank liquidity, such as capital adequacy (CAR) and asset quality (NPL). Consequently, the possibility of omitted-variable effects cannot be completely ruled out. Fourth, the observation period consists of only five years ($T = 5$), whereas the asymptotic properties of Driscoll-Kraay standard errors rely on a relatively long time dimension. In addition, the FEM was selected even though the Hausman test was not significant, resulting in relatively lower estimation efficiency compared with REM. The significance of H4 and H7 also depends on the Driscoll-Kraay correction, as both relationships were not statistically significant when bank-level cluster-robust standard errors were used. Fifth, the model residuals are not normally distributed and exhibit heteroskedasticity, autocorrelation, and cross-section dependence. Although these issues have been addressed using Driscoll-Kraay standard errors and bootstrap procedures, the findings should nevertheless be interpreted with caution. Sixth, the sample is limited to 40 conventional commercial banks listed on the Indonesia Stock Exchange during 2021–2025. Therefore, the findings may not be generalizable to Islamic banks, unlisted banks, or other observation periods. Seventh, Funding-Based Liquidity in this study is a ratio calculated based on the funding structure using the formula of Bank Indonesia (2015). It is not necessarily identical to the regulatory ratio published by banks because of differences in the scope of components and the consolidation basis. Eighth, the term "effect" in this study refers to the statistical relationship obtained from the econometric estimation of panel data and does not constitute an absolute claim of causality (Sekaran & Bougie, 2020; Wooldridge, 2010). The findings are therefore most appropriately understood as empirical relationships identified within the specified model and research context. These limitations provide important qualifications for interpreting the findings and identify opportunities for future research to incorporate substantive governance-quality measures, additional control variables, alternative efficiency and liquidity measures, longer observation periods, and broader banking contexts.

5.5 Directions for Future Research

Future research is encouraged to complement the structural measures of the Proportion of Independent Commissioners and the Proportion of the Audit Committee with substantive dimensions of monitoring quality, such as meeting frequency, financial expertise, member competence, and substantive independence. Such measures may provide a more comprehensive assessment of the effectiveness of governance mechanisms.

Future studies should also consider incorporating additional control variables that are theoretically and empirically relevant to Funding-Based Liquidity, such as asset quality, capital adequacy, funding structure, or ownership structure, given the relatively low R^2 values observed in the present study. Further research may also examine alternative mediating or moderating variables, including risk management, credit quality, funding structure, and bank ownership characteristics, because Operational Efficiency did not demonstrate a significant mediation role in any of the tested pathways.

Expanding the sample to include Islamic banks, unlisted banks, or a longer observation period is also recommended to assess the generalizability and temporal stability of the findings. Comparative studies across different types of banks and regulatory environments may further clarify whether the relationships identified in this study are specific to conventional commercial banks in Indonesia or reflect broader patterns in the banking sector.

For bank management, continued efforts to

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strengthen Operational Efficiency, particularly BOPO, are recommended as part of strategies to maintain intermediation capacity, while the role of Independent Commissioners in directly monitoring credit and funding decisions should continue to be optimized. For regulators, particularly the Otoritas Jasa Keuangan, continued efforts to strengthen the substantive quality of Audit Committee oversight are relevant because the quantitative ratio of committee members did not demonstrate a significant effect on operational efficiency or bank liquidity during the research period.

Future research may also continue to apply robustness procedures, including diagnostic testing, outlier detection, winsorization, robust standard errors, and bootstrap-based mediation analysis, particularly when working with financial panel datasets characterized by non-normal residuals and dependence across observations.

In summary, the study demonstrates that, among conventional commercial banks in Indonesia during 2021–2025, the statistically supported relationships are the direct positive relationship between the Proportion of Independent Commissioners and Funding-Based Liquidity and the negative relationship between Operational Efficiency and Funding-Based Liquidity. The Proportion of the Audit Committee and Bank Size do not demonstrate significant effects on the examined outcomes, while Operational Efficiency does not function as a mediator in any of the proposed relationships. These findings reinforce the importance of distinguishing structural governance characteristics from substantive governance effectiveness and of considering operational efficiency as a distinct dimension in understanding bank liquidity.

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