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The Effect of Capital Adequacy, Credit Risk, and Cost Efficiency on Profitability in the Banking Sector Listed on the Indonesia Stock Exchange for the 2020–2024 Period

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ABSTRACT

Banking profitability constitutes the principal analytical concern of this investigation, wherein the explanatory contributions of capital adequacy, credit impairment, and operational cost-effectiveness are scrutinised across financial institutions publicly traded on the Indonesia Stock Exchange (IDX) throughout 2020–2024. Adopting a quantitative associative design, the empirical inquiry encompasses 30 banking institutions selected through purposive sampling. Documentary evidence was collated from corporate annual reports alongside authoritative disclosures issued by the IDX and the Financial Services Authority (OJK). Operationalisation of the research constructs involves Return on Assets (ROA) as the profitability proxy, Capital Adequacy Ratio (CAR) as the capital sufficiency indicator, Non-Performing Loan (NPL) as the credit deterioration metric, and the Operating Expenses to Operating Income (BOPO) ratio as the measure of operational efficiency. Empirical examination incorporates descriptive statistical procedures, classical assumption diagnostics, and multivariate linear regression, complemented by partial (t-test) and simultaneous (F-test) inferential assessments. The empirical findings reveal that neither capital adequacy nor credit risk exerts a statistically discernible influence on profitability; conversely, operational inefficiency demonstrates an inverse and statistically significant association with banking returns. Ceteris paribus, the collective explanatory variables exhibit a statistically significant effect on the profitability of banking institutions.

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1. INTRODUCTION

Within the macroeconomic architecture, banking institutions constitute pivotal instruments for catalysing economic expansion while safeguarding national monetary equilibrium (Wibowo et al., 2025). Their intermediary mandate encompasses the mobilisation of societal deposits, subsequently channelled towards credit facilities for economic agents requiring external capital. Such financial intermediation engenders more efficacious resource circulation, accelerates capital formation, and underpins enduring socioeconomic advancement (Kubert ein et al., 2025). From a financial assessment perspective, profitability constitutes a cardinal metric through which institutional performance is appraised, denoting the capacity to derive financial yields from judicious resource deployment and operational undertakings (Rinofah et al., 2022). Its significance transcends conventional commercial aspirations, insofar as profitability embodies managerial dexterity in administering economic resources with optimal efficacy and allocative efficiency. Sustained earnings performance consequently reinforces institutional viability, consolidates depositor confidence, and preserves financial soundness across banking establishments (Arifian & Noor, 2022). Moreover, the magnitude of profitability elucidates management's proficiency in asset optimisation, fund mobilisation, and financing disbursement, thereby securing commensurate financial returns (Hariyanto & Maryono, 2025). Institutions exhibiting persistent earnings resilience generally command greater latitude to enlarge operational capacity, discharge customer obligations, and attenuate prospective financial exposures. Conversely, deteriorating profitability may signify deficiencies in governance mechanisms and suboptimal resource deployment, potentially precipitating institutional fragility alongside diminished stakeholder confidence (Suryana & Manda, 2022). Accordingly, profitability assumes considerable relevance *inter alia* for investment constituencies, supervisory authorities, and executive management in scrutinising value generation, competitive positioning, and prospective financial viability over an extended horizon (Paparo et al., 2024).

An examination of Indonesia's banking performance throughout 2020–2024 reveals a fluctuating earnings trajectory, empirically discernible through profitability indicators documented in the Indonesian Banking Statistics issued by the Financial Services Authority (Otoritas Jasa Keuangan/OJK). The following figure illustrates the trajectory of profitability ratios across the banking industry during the 2020–2024 observation period.

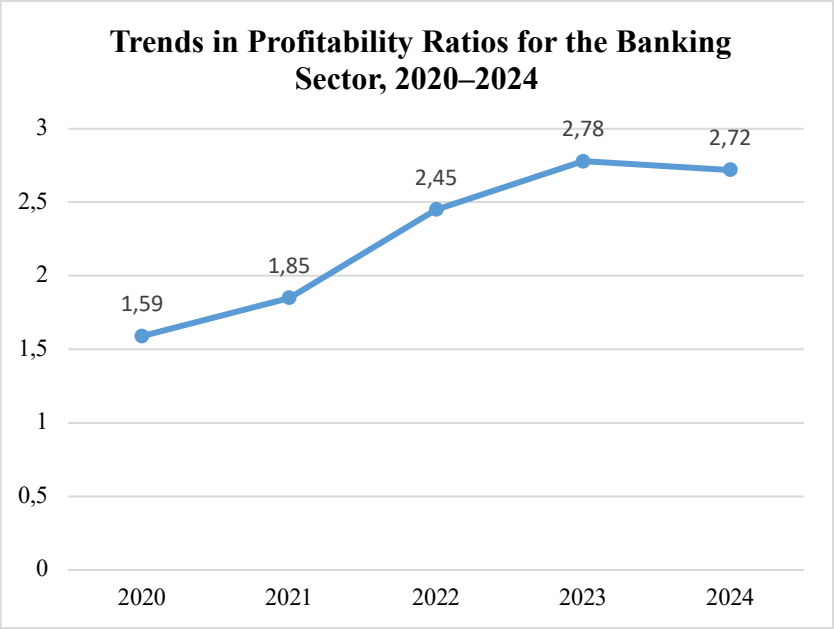

Figure 1. Profitability Ratio Trajectory across the Banking Industry, 2020–2024.

Figure 1 delineates the temporal trajectory of banking profitability, revealing an upward movement from 1.59% in 2020 to 1.85% in 2021, notwithstanding the macroeconomic perturbations engendered by the COVID-19 outbreak, which substantially impaired economic transactions and financial intermediation. Such exogenous disturbances precipitated heightened lending vulnerabilities, diminished borrowers' repayment capabilities, and attenuated credit demand across the banking industry. Subsequent economic normalization was accompanied by an appreciable enhancement in profitability, with the ratio ascending to 2.45% in 2022 and subsequently attaining 2.78% in 2023. Notwithstanding this progressive amelioration, a marginal contraction to 2.72% occurred in 2024, suggesting that the restoration of banking earnings had yet to achieve sustained consistency. This fluctuating trajectory underscores the persistence of structural impediments to earnings optimization, particularly those pertaining to credit exposure mitigation, capital sufficiency, and expenditure rationalization. Such phenomena may be interpreted through the analytical lens of Financial Intermediation Theory, formulated by Gurley and Shaw (1958), wherein banking institutions are conceptualized as intermediating entities that channel financial resources between surplus-bearing and deficit-bearing economic units. The efficacy of this intermediary mechanism is contingent upon sufficient capital reserves for loss absorption, judicious lending-risk mitigation to curtail default probabilities, and operational rationalization to maximize resource deployment. Hence, profitability is not exclusively contingent upon fund-disbursement capacity; rather, it is concomitantly conditioned by prudential risk governance and allocative efficiency. This theoretical proposition corroborates the observations of Santosa and Lestari (2026), who underscore the consequential association between internal banking governance determinants and institutional profitability.

From an institutional perspective, capital adequacy constitutes a pivotal endogenous determinant of profitability, reflecting the capacity of banking entities to preserve operational continuity while cushioning prospective pecuniary impairments arising from intermediation undertakings (Tahu et al., 2025). Sufficient capitalization functions as a protective financial reserve, simultaneously facilitating productive asset deployment and sustainable income generation (Aji & Putri, 2025). However, capital accumulation does not invariably translate into superior financial outcomes, given that capitalization disequilibrium may engender divergent consequences. Under-capitalization amplifies vulnerability to financial impairment, whereas excessive capitalization, absent commensurate productive deployment, potentially engenders fund idleness, allocative inefficiency, and foregone opportunities for return maximization (Wardana & Setiadi, 2023). Beyond capitalization considerations, lending-related vulnerability represents another consequential determinant of banking performance. Conceptually, credit risk denotes prospective pecuniary impairment attributable to borrowers' incapacity to discharge stipulated contractual liabilities (Sunaryo et al., 2021). Deterioration in financing portfolio integrity, commonly manifested through escalating non-performing loans, may intensify financial encumbrances, undermine asset soundness, and consequently erode earnings capacity. Moreover, deficiencies in prudential oversight may jeopardize operational continuity and institutional solvency (Suryana & Manda, 2022). Conversely, rigorous debtor appraisal, continuous exposure surveillance, and anticipatory default mitigation can reinforce institutional resilience while fostering earnings expansion. Accordingly, elevated credit exposure may signify deficiencies in borrower-screening procedures and post-disbursement supervision, thereby imposing deleterious repercussions upon aggregate financial performance (Suhartono et al., 2023).

Equally consequential to earnings determination is the institution's capacity to rationalize expenditures through judicious resource deployment and stringent operational outlay

governance. Expenditure optimization enables financial institutions to curtail superfluous disbursements, enhance budgetary absorption, and strengthen their capacity for profit generation (Prayoga et al., 2022). Within the broader paradigm of financial sustainability, such operational rationalization constitutes an instrumental mechanism for reinforcing institutional resilience and competitive positioning, inter alia, through the augmentation of revenue-generating potential and service-delivery standards. Conversely, inadequate expenditure surveillance may precipitate operational cost escalation, thereby constraining profitability and diminishing overall financial performance (Fadhilah & Suprayogi, 2019).

An examination of extant scholarly evidence discloses considerable heterogeneity in the reported associations linking banking profitability with capital adequacy, credit risk, and cost efficiency. Divergent empirical trajectories are apparent across previous investigations. Suwandi (2017), for instance, established statistically significant associations between profitability, capital adequacy, and cost efficiency, although credit risk failed to demonstrate a discernible effect. Conversely, the empirical assessment undertaken by Permatasari and Utiyati (2018) revealed an inverse yet statistically non-significant association between capital adequacy and profitability, whereas both credit risk and cost efficiency manifested significant negative relationships. Evidence furnished by Rinofah et al. (2022) subsequently corroborated the statistical significance of capital adequacy, notwithstanding the positive but insignificant coefficient associated with credit risk. Their investigation likewise ascertained an adverse and statistically significant relationship between cost efficiency and profitability. A comparable empirical configuration emerged in Wibowo et al. (2025), whose findings substantiated a significant positive contribution of capital adequacy, an inconsequential statistical association involving credit risk, and a significant inverse relationship attributable to cost efficiency. Such discrepancies, *inter alia*, underscore the persistence of an unresolved empirical lacuna concerning the interrelationships among the aforementioned constructs. Accordingly, the heterogeneity of extant findings furnishes a compelling justification for renewed empirical scrutiny through alternative observational units and temporal configurations, thereby facilitating a more encompassing evidentiary assessment. Beyond this consideration, the present investigation advances a contextual contribution through its concentration on the 2020–2024 interval, encompassing the post-pandemic transition and the subsequent trajectory of domestic economic revitalization. The selected timeframe warrants particular scholarly attention insofar as banking institutions encountered substantial fluctuations in credit exposure, financing operations, and institutional operating policies. Examination of the specified associations throughout this transitional interval may therefore elucidate additional determinants underpinning banking profitability amid heterogeneous macroeconomic circumstances.

For analytical purposes, the observational entities comprise commercial banking institutions whose securities were listed on the Indonesia Stock Exchange (IDX) throughout the 2020–2024 research horizon. This delimitation is predicated upon the accessibility of recurrently disclosed financial statements, the publication of which is governed by transparency obligations and subjected to independent audit examinations. Such institutional safeguards constitute an essential foundation for maintaining the veracity, consistency, and accountability of financial observations incorporated into the quantitative estimation procedure. Moreover, IDX-listed banking entities offer a pertinent representation of Indonesia's domestic banking landscape, wherein institutional activities remain subject to the regulatory and prudential oversight administered by the Financial Services Authority. In light of the aforementioned empirical incongruities, evolving sectoral circumstances, and considerations pertaining to research design, the present inquiry seeks to ascertain the extent to which capital adequacy, credit risk, and cost efficiency exert explanatory effects upon the profitability of banking institutions listed on the Indonesia Stock Exchange over the 2020–2024 observation horizon.

1.1. Literature Review

Financial Intermediation Theory

Banking profitability is fundamentally contingent upon the institution's capacity to reconcile capital adequacy, credit-risk mitigation, and expenditure rationalization within its lending operations. These interdependent determinants govern loss absorption, resource deployment, and the conversion of credit extension into sustainable earnings. Such operational imperatives are intrinsically linked to the financial intermediation paradigm articulated by Gurley and Shaw (1958), wherein banks function as institutional conduits channeling monetary surpluses from depositors towards economic agents experiencing funding deficits. Through this intermediary architecture, mobilized public deposits are subsequently transformed into credit provisions intended to stimulate productive economic undertakings. Beyond this allocative function, Mishkin (2011) elucidates that banking institutions also undertake risk containment and safeguard systemic financial resilience. From an operational-performance standpoint, Siringoringo (2017) delineates the nexus between intermediation quality and institutional efficiency, particularly concerning the judicious deployment of available resources to engender profitability. Corroboratively, Fitrayansyah and Fadli (2024) contend that efficacious fund mobilization and redistribution between surplus-bearing and deficit-incurring economic entities reinforce overall financial-system stability. Nevertheless, the perpetuation of intermediary activities remains contingent upon sufficient capitalization, prudent credit-risk governance, and operational cost-effectiveness. Accordingly, the confluence of these dimensions constitutes an indispensable prerequisite for sustaining lending capacity, containing prospective financial impairment, and optimizing institutional earnings. Consequently, financial intermediation, *ceteris paribus*, becomes a pivotal determinant of banking profitability when underpinned by robust capital stewardship, stringent credit-risk oversight, and judicious cost containment.

Profitability

Banking-sector profitability denotes an institution's pecuniary capacity to procure financial returns through viable commercial undertakings and judicious asset deployment. Among the prevailing metrics, Return on Assets (ROA) serves as an instrumental proxy for ascertaining the extent to which aggregate asset holdings engender earnings (Putri et al., 2018). Within the earnings dimension of banking soundness appraisals, ROA assumes a pivotal evaluative function, delineating managerial proficiency in harnessing productive resources for income generation (Susanto et al., 2026). Its sustained upward trajectory may, prima facie, signify ameliorating financial outcomes alongside enhanced operational resilience. Moreover, sufficient earnings performance conveys an affirmative indication of corporate prospects and enduring commercial viability (Hanafia & Karim, 2020). In light of this rationale, the present investigation operationalizes profitability through ROA, ascertained via the proportion of pre-tax net income to aggregate assets, thereby appraising the efficacy of banking institutions in converting asset resources into pecuniary gains.

Capital Adequacy

The magnitude of a bank’s capital endowment delineates its financial resilience in confronting prospective impairments engendered by commercial undertakings and operational exposures. As an absorptive safeguard, equity reserves furnish a protective cushion against unforeseen pecuniary detriments, notably those emanating from lending commitments and intermediation functions. Within this analytical framework, Difa et al. (2022) conceptualize the Capital Adequacy Ratio (CAR) as an evaluative metric denoting whether institutional capital provisions suffice to accommodate multifarious risk exposures while remaining consonant with prudential mandates. This conceptualization is further substantiated by Amalia

and Diana (2022), who construe CAR as an indication of a bank's endogenous financial capacity to withstand prospective losses attributable to operational undertakings, particularly credit-related vulnerabilities. From a prudential standpoint, robust capitalization underpins institutional solvency, safeguards business perpetuity, and augments the latitude available for risk mitigation without disrupting ongoing operations. Higher CAR realizations may consequently signify enhanced loss-absorption capacity, thereby fostering more conducive conditions for financial soundness and earnings generation. Accordingly, CAR is operationalized herein as the proxy for capital adequacy, capturing the relative magnitude of available capital vis-à-vis risk-weighted assets.

Credit Risk

Within banking operations, credit risk denotes the prospective pecuniary impairment occasioned by obligors' failure to discharge stipulated repayment commitments, particularly those emanating from credit extension (Sunaryo et al., 2021). Its magnitude is conventionally ascertained through the Non-Performing Loan (NPL) ratio, delineating the fraction of impaired credit facilities vis-à-vis aggregate outstanding advances. From an asset-quality perspective, Lestari and Setianegara (2020) posit that NPL quantifies financing exposures whose repayment has deviated from predetermined contractual provisions, thereby furnishing an evaluative benchmark for credit oversight efficacy and portfolio soundness. In a complementary assessment, Widyastuti and Aini (2021) conceptualize this ratio as an analytical apparatus for discerning the magnitude of credit exposure, notably the likelihood of obligors reneging on their pecuniary commitments. Deterioration in this indicator may precipitate portfolio impairment, constrict interest-derived revenue, and engender augmented provisions for credit losses, with adverse repercussions for institutional profitability. Conversely, a diminished NPL proportion signifies superior lending quality and more efficacious risk-governance mechanisms, potentially underpinning the continuity of earnings generation. Accordingly, the present investigation operationalizes credit risk through the NPL ratio, thereby quantifying impaired advances relative to the banking institution's aggregate credit portfolio.

Cost Efficiency

Within the banking sector, operational frugality denotes an institution's proficiency in calibrating resource disbursement against pecuniary returns accruing from commercial undertakings. Its empirical ascertainment frequently relies upon the Operating Expenses to Operating Income ratio (BOPO), an accounting metric delineating the relative magnitude of expenditure vis-à-vis aggregate operating revenue (Suryadi et al., 2020). From a profitability standpoint, Syakhrun et al. (2019) underscore BOPO's consequential role in determining financial returns, insofar as the ratio encapsulates managerial dexterity in curtailing overhead burdens whilst augmenting revenue-generating capacity. Corroboratively, Astuti (2022) conceptualizes this indicator as an instrument for appraising managerial competence in sustaining equilibrium between pecuniary outlays and operating proceeds. Empirically, a diminished BOPO value signifies heightened productive efficiency, whereby revenue accrual can be sustained through comparatively restrained expenditure, thereby fostering wider profit margins and enhanced profitability. Conversely, an elevated ratio denotes disproportionate operational disbursements vis-à-vis income generation, potentially constraining earnings and attenuating overall financial performance. Accordingly, BOPO is operationalized herein as the principal proxy for cost efficiency, facilitating an assessment of banking institutions' expenditure governance relative to operating income.

Hypothesis Development

The Effect of Capital Adequacy on Profitability

Within the banking milieu, capital adequacy denotes the institutional capacity to withstand prospective financial impairments while sustaining uninterrupted operational continuity. Viewed through the theoretical prism of *Financial Intermediation Theory*, capital sufficiency constitutes an indispensable prerequisite for discharging intermediary responsibilities, encompassing fund mobilization and subsequent allocation to financing-seeking economic agents. Robust capitalization consequently fortifies institutional resilience, facilitates risk mitigation, and expands credit-disbursement capacity, potentially engendering superior earnings performance (Amalia & Diana, 2022; Anggraini et al., 2022; Aji & Putri, 2025).

Empirical investigations undertaken by Sudarsana & Suarjaya (2019), Khotimah & Setiawati (2022), and Yanti & Akbar (2025) substantiate the association between capitalization sufficiency and bank profitability. Collectively, these empirical observations suggest that an adequate capital buffer facilitates operational efficacy while reinforcing the institutional capacity to accrue financial returns. Accordingly, the following proposition is advanced as the first research hypothesis:

H_1: Capital adequacy affects profitability.

The Effect of Credit Risk on Profitability

Within the *Financial Intermediation Theory*, banking institutions assume a pivotal intermediary capacity through the redistribution of mobilized deposits into credit facilities, notwithstanding the attendant susceptibility to borrower delinquency. Credit risk, *inter alia*, embodies prospective pecuniary impairment occasioned by a debtor's inability to discharge stipulated repayment covenants. Although loan extensions constitute a remunerative source of interest-derived revenue, their deployment concomitantly engenders exposure to default contingencies. Escalating credit impairment may precipitate an accumulation of non-performing loans, attenuate interest receipts, and amplify prospective financial detriments, thereby constraining institutional profitability and diminishing banks' earnings-generating capacity (Sunaryo et al., 2021; Sembiring, 2021; Fitrayansyah & Fadli, 2024).

Empirical investigations by Khotimah & Setiawati (2022) and Safitri & Mukharomah (2023) substantiate an inverse and statistically significant association between credit risk and profitability. Such empirical evidence elucidates how asset-quality deterioration, particularly through mounting non-performing loans, may undermine financial performance and curtail the capacity to generate earnings. *Ex consequenti*, the second hypothesis is advanced as follows:

H_2: Credit risk affects profitability.

The Effect of Cost Efficiency on Profitability

Operational cost efficiency denotes a financial institution's proficiency in regulating expenditure outlays vis-à-vis revenue acquisition. Within the conceptual purview of *Financial Intermediation Theory*, banking efficacy is contingent not merely upon fund mobilization and subsequent disbursement, but equally upon judicious resource deployment. Expenditure rationalization, accordingly, facilitates resource optimization, sustains institutional operability, and augments prospective earnings generation (Suryadi et al., 2020; Siringoringo, 2017).

Empirical substantiation furnished by Nuryanto et al. (2020), Sudarsana & Suarjaya (2019), Sanjaya & Badjuri (2024), Anggraini et al. (2022), Aji & Putri (2025), and Widari et al. (2021) elucidates the nexus between expenditure efficiency and bank profitability. Collectively, these investigations underscore that prudent cost governance engenders superior operational efficacy and reinforces financial institutions' profit-generating capacity. *Ergo*, the ensuing proposition is articulated as the third hypothesis:

H_3: Cost efficiency affects profitability.

Conceptual Framework

The analytical schema delineates the contributory nexus of Capital Adequacy, Credit Risk, and Cost Efficiency vis-à-vis banking profitability, encompassing financial institutions domiciled on the Indonesia Stock Exchange (IDX) throughout the 2020–2024 temporal interval. The conceptual framework illustrating the proposed relationships among the research variables is presented in Figure 2.

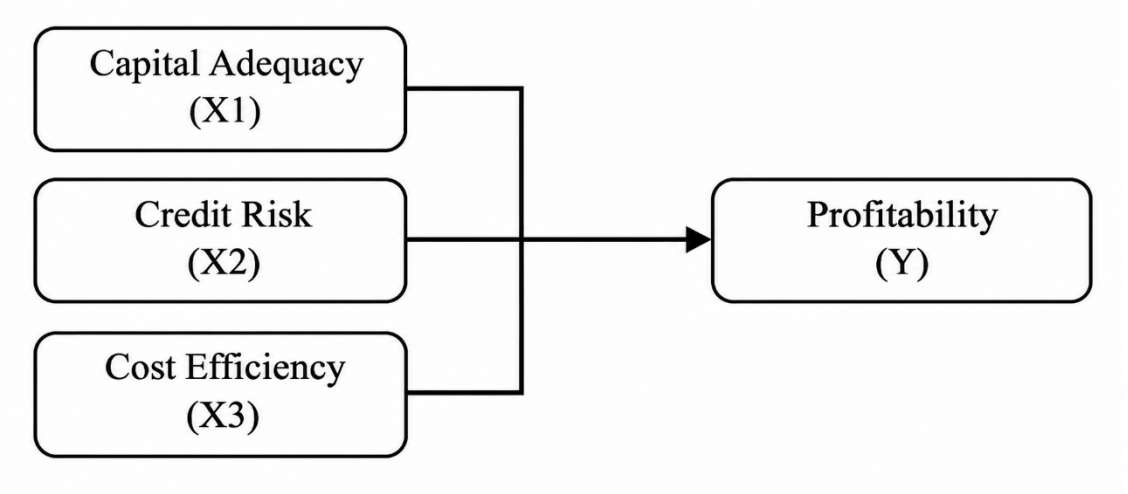

Figure 2. Conceptual Framework

Financial performance, operationalized as Profitability, constitutes the endogenous construct, whose variability is appraised vis-à-vis three principal explanatory dimensions: Capital Adequacy, Credit Risk, and Cost Efficiency.

2. RESEARCH METHOD

An empirical quantitative framework, specifically associative in orientation, underpins this investigation into the extent to which capital adequacy, lending-related credit exposure, and operational cost-efficiency determine banking-sector profitability, consistent with the methodological conception advanced by Sugiyono (2013). The observational universe encompasses banking entities maintaining IDX (Indonesia Stock Exchange) listings throughout 2020–2024. Sample constitution was governed by criterion-based purposive selection, whereby eligibility necessitated uninterrupted admission to the IDX Main Board, classification as a conventional banking institution, successive publication of annual financial statements, exhaustive disclosure of data pertinent to the investigated constructs, and uninterrupted exchange-listing status without delisting. Application of these eligibility stipulations yielded 30 qualifying banking institutions.

Documentary secondary evidence constitutes the empirical foundation, retrieved from annual corporate disclosures disseminated through the IDX institutional portal, respective bank websites, Indonesian Banking Statistics (SPI), and Financial Services Authority (OJK) releases. Asset-based profitability serves as the endogenous construct, operationalized through Return on Assets (ROA); meanwhile, prudential capital strength is proxied by the Capital Adequacy Ratio (CAR), impaired-credit exposure by the Non-Performing Loan (NPL) ratio, and operational expenditure efficiency by the Operating Expenses to Operating Income (BOPO) ratio.

An analytical sequence incorporating descriptive statistical procedures and classical regression diagnostics is implemented prior to inferential estimation. The diagnostic protocol encompasses distributional normality, inter-predictor multicollinearity, heteroscedastic variance, and serial autocorrelation assessments. Subsequently, multivariate linear regression provides the econometric basis for appraising both the partial contributions and collective explanatory effects of the independent constructs upon banking profitability. The corresponding regression specification is formulated as follows:

$$\boldsymbol{ROA = \alpha + \beta_1 CAR + \beta_2 NPL + \beta_3 BOPO + \varepsilon}$$

Where:

ROA = Return on Assets (profitability)
α = Constant
β_1, β_2, β_3 = Regression coefficients
CAR = Capital Adequacy Ratio
NPL = Non-Performing Loan ratio
BOPO = Operating Expenses to Operating Income ratio
ε = Error term

Statistical inference is effectuated through partial and simultaneous significance assessments, employing the t-statistic and F-statistic, respectively, under a predetermined alpha threshold of 5%. With respect to individual predictor contributions, the t-test ascertains their respective influence on banking profitability, whereas the F-test establishes the collective explanatory significance of the regressors. Inferential outcomes are adjudged statistically consequential when the probability coefficient falls beneath 0.05; conversely, values exceeding this critical benchmark denote an absence of statistical significance. Additionally, the Adjusted R-squared coefficient quantifies the regression specification's explanatory adequacy in elucidating fluctuations in banking profitability (Ghozali, 2011).

3. RESULT AND DISCUSSION

Data Description

The empirical investigation encompasses banking entities incorporated in the Indonesia Stock Exchange (IDX) throughout 2020–2024, wherein institutional soundness is operationalized through the Capital Adequacy Ratio (CAR), lending-related exposure through the Non-Performing Loan (NPL) ratio, and expenditure rationalization through the Operating Expenses to Operating Income (BOPO) ratio, all designated as exogenous constructs, whereas Return on Assets (ROA) constitutes the endogenous profitability indicator. Empirical observations were retrieved from corporate annual disclosures, employing documentary extraction as the principal data-acquisition procedure. Sample ascertainment was conducted via criterion-based purposive selection, yielding 30 banking institutions satisfying the stipulated inclusion parameters. Accordingly, the five-year longitudinal coverage generated an aggregate dataset comprising 150 firm-year observations.

An intertemporal appraisal of banking-sector indicators over the 2020–2024 horizon delineates substantial cross-sectional heterogeneity across four analytical dimensions, namely capital resilience, credit exposure, operational expenditure efficiency, and asset-based profitability. Regarding capital adequacy, proxied by CAR, pronounced disparities emerge across the sampled institutions: Krom Bank Indonesia Tbk (BBSI) manifests the pre-eminent mean ratio of 164.05%, whereas Bank Mayapada Internasional Tbk (MAYA) registers the nadir at 12.44%. A comparable dispersion is discernible in credit-risk characteristics, as evidenced by the NPL indicator, with Bank Amar Indonesia Tbk (AMAR) exhibiting the maximum average delinquency ratio of 7.74%, in contradistinction to Bank Capital Indonesia

Tbk (BACA), whose corresponding figure reaches merely 0.06%. From an operational standpoint, BOPO-based measurements disclose divergent cost-containment capabilities, whereby Bank Raya Indonesia Tbk (AGRO) incurs the highest mean proportion at 133.11%, while Bank Central Asia Tbk (BBCA) demonstrates the most parsimonious expenditure configuration, registering 48.57%. With respect to earnings-generating capacity, ROA measurements likewise substantiate heterogeneous profitability profiles among the investigated institutions. BBCA occupies the foremost position with an average ROA of 3.98%, marginally preceding BBSI at 3.90%; conversely, Bank Neo Commerce Tbk (BBYB) records the lowest mean profitability, amounting to -3.89%. Collectively, these descriptive observations substantiate the existence of inter-institutional disparities in capital adequacy, asset-quality conditions, operational expenditure governance, and profitability among the 30 IDX-listed banking institutions during the 2020–2024 observation horizon.

Descriptive Statistical Analysis

An empirical synopsis of the dataset is established through descriptive statistical procedures, whereby numerical attributes encompassing extremal observations, arithmetic averages, and dispersion coefficients are systematically scrutinized. The investigative framework comprises four principal constructs, namely capital adequacy, credit risk, operational cost efficiency, and profitability, whose distributional properties are delineated through the computational outputs subsequently exhibited in Table 1.

Table 1. Descriptive Statistics Results

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Capital Adequacy	133	0.11	1.70	0.3131	0.19678
Credit Risk	133	0.00	0.08	0.0257	0.01572
Cost Efficiency	133	0.04	1.11	0.8234	0.14226
Profitability	133	-0.01	0.05	0.0143	0.01193
Valid N (listwise)	133				

Source: Empirical computations derived from SPSS version 25 (2026).

Descriptive statistical appraisal encompasses 133 valid observations for each of the four examined constructs. Regarding capital adequacy, the recorded distribution extends from 0.11 to 1.70, yielding an arithmetic mean of 0.3131 alongside a standard deviation of 0.19678. Credit risk demonstrates a narrower numerical dispersion, bounded by 0.00 and 0.08, with a corresponding mean of 0.0257 and standard deviation of 0.01572. Cost efficiency, *inter alia*, manifests values between 0.04 and 1.11, attaining an average of 0.8234 and a dispersion coefficient, expressed through standard deviation, of 0.14226. Conversely, profitability exhibits a negative lower boundary of -0.01 and an upper threshold of 0.05, accompanied by a mean of 0.0143 and standard deviation of 0.01193. Collectively, these statistical parameters delineate the respective distributions, central positioning, and variability of the investigated banking-sector indicators across the sampled institutional entities.

Classical Assumption Tests

Normality and Autocorrelation Tests

Distributional normality of the regression residuals was scrutinized via the One-Sample Kolmogorov–Smirnov criterion, whereas serial dependence among residual observations was appraised through the Durbin–Watson metric. The empirical outcomes of the normality assessment and autocorrelation diagnostics are delineated in Table 2.

Table 2. Normality and Autocorrelation Test Results

Test	Statistic	Value	Significance / Reference

One-Sample Kolmogorov–Smirnov	Test statistic	0.047	—
One-Sample Kolmogorov–Smirnov	Asymp. Sig. (2-tailed)	0.200	0.05
Durbin–Watson	DW statistic	1.045	−2 to +2

Source: Empirical computations derived from SPSS version 25 (2026).

With respect to residual diagnostics, the Durbin–Watson coefficient registered at 1.045, remaining within the stipulated −2 to +2 interval and thus denoting an absence of autocorrelation prima facie. Concurrently, the Kolmogorov–Smirnov assessment yielded an Asymp. Sig. of 0.200, surpassing the $\alpha = 0.05$ benchmark, thereby substantiating the residual distribution's conformity to the normality assumption.

Multicollinearity and Heteroscedasticity Tests

Collinearity diagnostics entailed tolerance coefficients and VIF indices, whereas heteroscedastic disturbances were scrutinised through Spearman's rho inferential significance. The empirical outcomes of multicollinearity and heteroscedasticity diagnostics are delineated in Table 3.

Table 3. Multicollinearity and Heteroscedasticity Test Results

Independent Variable	Tolerance	VIF	Spearman's rho Sig. (2-tailed)
Capital Adequacy	0.950	1.053	0.151
Credit Risk	0.814	1.229	0.722
Cost Efficiency	0.848	1.180	0.778

Source: Empirical computations derived from SPSS version 25 (2026).

Diagnostic scrutiny revealed tolerance coefficients spanning 0.814–0.950, accompanied by VIF estimates of 1.053–1.229, thereby substantiating the absence of deleterious collinearity across the explanatory covariates. All tolerance metrics exceeded the prescribed 0.10 threshold, whereas their corresponding VIF magnitudes remained beneath 10. Furthermore, Spearman's rho yielded significance probabilities of 0.151 for capital adequacy, 0.722 for credit risk, and 0.778 for cost efficiency; each surpassed the 0.05 criterion, thus indicating homoscedasticity *in accordance with* the diagnostic parameters employed.

Multiple Linear Regression Analysis

Banking profitability was empirically appraised through a multivariate regression framework, wherein capital adequacy, credit exposure, and operational cost efficiency constituted the explanatory determinants; concomitantly, the resultant parameter estimates and partial inferential outcomes are consolidated in Table 4.

Table 4. Multiple Linear Regression and Partial t-Test Results

Variable	Unstandardized B	Std. Error	t-statistic	Sig.
Constant	0.082	0.001	62.718	0.000
Capital Adequacy	−0.00002547	0.001	−0.023	0.982
Credit Risk	−0.010	0.015	−0.023*	0.523
Cost Efficiency	−0.082	0.002	−49.795	0.000

Source: Empirical computations derived from SPSS version 25 (2026).

Inferential appraisal of the model yielded inverse parameter estimates for capital adequacy, credit risk, and cost efficiency, quantified at −0.00002547, −0.010, and −0.082, respectively. Regarding partial effects, capital adequacy exhibited no statistically discernible association with profitability ($t = -0.023$; $p = 0.982$); credit risk likewise failed to attain significance ($p = 0.523$). Conversely, cost efficiency manifested a deleterious, statistically robust relationship with profitability ($t = -49.795$; $p < 0.001$). Accordingly, the evidence leaves H1 and H2 unsubstantiated, while H3 receives corroboration. The model's specification is expressed as

follows: Profitability = 0.082 − 0.00002547(Capital Adequacy) − 0.010(Credit Risk) − 0.082(Cost Efficiency) + e.

Hypothesis Testing

Partial t-Test

At a 5% significance threshold (0.05), the t-test delineates whether capital adequacy, credit risk, and operational cost efficiency exert individually discernible influences upon profitability. Statistical inference is predicated upon the corresponding p-values, whereby observations falling beneath 0.05 substantiate significant individual associations, whereas values exceeding this critical boundary denote statistically inconclusive effects on the dependent construct. The empirical outcomes of individual parameter significance assessments are delineated in Table 5, presenting the Partial t-Test Results.

Table 5. Partial t-Test Results

Variable	Regression Coefficient (B)	t-statistic	Sig.
Constant	0.082	62.718	0.000
Capital Adequacy	−0.00002547	−0.023	0.982
Credit Risk	−0.010	−0.023*	0.523
Cost Efficiency	−0.082	−49.795	0.000

Source: Empirical computations derived from SPSS version 25 (2026).

Profitability exhibited divergent responses across the explanatory variables. Cost efficiency emerged as the sole statistically consequential determinant, registering a negative coefficient of −0.082, a t-statistic of −49.795, and a significance level of 0.000 ($p < 0.001$), thereby substantiating H3. Conversely, capital adequacy yielded a marginally negative estimate of −0.00002547 ($t = −0.023$; $p = 0.982$), while credit risk manifested a coefficient of −0.010 ($p = 0.523$); both relationships remained statistically inconclusive. Accordingly, H1 and H2 were unsubstantiated, whereas H3 was empirically corroborated.

Overall Model Fit and Coefficient of Determination

Joint inferential validity and model explicability were appraised through the F-statistic and determination coefficient, respectively, with the Durbin–Watson metric additionally documented. The empirical outcomes of the overall regression assessment are presented in Table 6.

Table 6. Overall Regression Model Results

R	R Square	Adjusted R Square	F-statistic	F-test Sig.	Durbin–Watson
0.979	0.958	0.957	984.860	0.000	1.045

Source: Empirical computations derived from SPSS version 25 (2026).

Collectively, the regressors exhibit pronounced explanatory potency, as evidenced by an Adjusted R Square of 0.957 and an R Square coefficient of 0.958, thereby accounting for 95.7% of the observed variability in banking profitability, with the residual 4.3% remaining contingent upon extraneous determinants beyond the model's specification. Concurrently, the omnibus F-test yields a statistic of 984.860 alongside a significance level of 0.000 ($p < 0.001$), substantiating the joint statistical significance of capital adequacy, credit risk, and cost efficiency vis-à-vis profitability.

Discussion

The Effect of Capital Adequacy on Profitability

Empirical estimation yields a t-statistic of -0.023, whose absolute magnitude remains beneath the critical benchmark of 1.979; concomitantly, the probability value of 0.982 substantially surpasses the prescribed significance level of 0.05. Such statistical evidence provides insufficient grounds for affirming a meaningful association between capital adequacy and profitability, thereby necessitating the rejection of H1. From an operational standpoint, capital accumulation does not invariably engender enhanced earnings, given that its principal raison d'être encompasses loss absorption, financial resilience, and adherence to prudential regulatory stipulations. Profit-generating capacity is likewise contingent upon asset soundness and the efficacy of capital deployment across income-producing activities. Within the conceptual purview of Financial Intermediation Theory, sufficient capitalization constitutes an indispensable prerequisite for operational continuity and risk mitigation; nevertheless, capital abundance per se remains insufficient to augment financial returns absent judicious resource allocation. Empirically, this outcome corroborates Anggraini et al. (2022), whose investigation likewise established an insignificant capital adequacy–profitability nexus, alongside Yanti and Akbar (2025), who documented a positive yet statistically inconsequential association. Contrariwise, Salamah and Puspitasari (2024) substantiated a positive and statistically significant relationship. Such empirical discrepancies may plausibly emanate from heterogeneity in sampling configurations, prevailing industrial circumstances, and institutional capital governance practices.

The Effect of Credit Risk on Profitability

Empirical evidence derived from the partial t-test substantiates the absence of a statistically discernible association between credit risk and profitability, as the computed t-statistic (−0.640) remains below the critical threshold (1.979) in absolute magnitude, whilst the probability coefficient (0.523) surpasses the prescribed significance level (0.05). Accordingly, the proposed H2 hypothesis cannot be sustained. Such an outcome intimates that variations in credit exposure do not invariably precipitate commensurate alterations in banking returns, considering that profitability is concomitantly contingent upon operational oversight, revenue maximization, and managerial proficiency in the judicious deployment of organizational resources. Within the conceptual purview of Financial Intermediation Theory, banking institutions perform an intermediary function by channeling financial surpluses from excess-fund entities towards deficit-bearing units through credit disbursement, thereby engendering interest-derived revenues. Notwithstanding, an erosion of creditworthiness may engender repayment delinquency, potentially undermining the institution's revenue-generating capacity. Nevertheless, the observed empirical configuration indicates that credit exposure, *per se*, does not constitute an autonomous and statistically significant predictor of profitability. This implies that the nexus between asset quality and earnings realization may remain contingent upon endogenous governance arrangements, managerial controls, and ancillary financial determinants. The foregoing inference corroborates the empirical observations documented by Widari et al. (2021), who likewise discerned an insignificant credit-risk–profitability association; *conversely*, it diverges from the conclusions advanced by Salamah and Puspitasari (2024), whose investigation substantiated a statistically significant relationship between the two constructs.

The Effect of Cost Efficiency on Profitability

The empirical evidence derived from partial hypothesis testing establishes a pronounced inverse association between operational cost efficiency and banking profitability, as evidenced by a t-statistic of -49.795, whose absolute magnitude surpasses the critical threshold of 1.979, alongside a significance level of 0.000, substantially beneath the stipulated alpha of 0.05; accordingly, H3 receives empirical substantiation. Such an adverse association elucidates that an escalation in the Operating Expenses to Operating Income ratio (BOPO) concomitantly

attenuates banks' earnings-generating capacity, whereas its diminution signifies enhanced expenditure governance and a more efficacious conversion of operating revenues into financial returns. Within the conceptual purview of Financial Intermediation Theory, the intermediation mechanism inherently entails pecuniary outlays arising from fund procurement and credit allocation, whereby disproportionate expenditure relative to the revenues engendered through these undertakings may precipitate margin compression and undermine institutional profitability. Consequently, stringent expenditure oversight constitutes an indispensable prerequisite for preserving the viability of financial intermediation and augmenting banking-sector financial performance. Corroborative evidence is furnished by Nuryanto et al. (2020), Sanjaya and Badjuri (2024), and Aji and Putri (2025), whose investigations likewise ascertain a statistically significant nexus between cost efficiency and profitability. Conversely, this empirical disposition diverges from the findings reported by Safitri and Mukharomah (2023), who discerned no statistically significant association between the aforementioned constructs.

4. CONCLUSION

Empirical evidence derived from banking institutions listed on the Indonesia Stock Exchange throughout 2020–2024 delineates an absence of statistically discernible associations between capital adequacy, credit risk, and profitability, with respective significance coefficients of 0.982 and 0.523, both surpassing the stipulated alpha level of 0.05. By contrast, operational inefficiency exerts a significantly adverse influence on earnings performance, whereby escalating operating expenditures vis-à-vis operating revenues attenuate the capacity of financial institutions to engender profits. Notwithstanding these individual relationships, the concomitant incorporation of capital adequacy, credit risk, and cost efficiency yields a statistically significant explanatory contribution to banking profitability, substantiated by an F-test probability of 0.000. Several methodological constraints, inter alia, warrant consideration, particularly the circumscribed specification of merely three exogenous constructs, alongside the delimited temporal horizon and institutional coverage, potentially impinging upon the external validity and generalizability of the empirical inferences. Accordingly, banking executives ought to accord precedence to expenditure rationalization and stringent operational oversight, concomitantly reinforcing capital buffers and instituting prudent credit governance to safeguard financial resilience and earnings sustainability. Subsequent scholarly inquiries should contemplate the incorporation of supplementary explanatory determinants and an expanded observation horizon, thereby facilitating a more comprehensive elucidation of the multifactorial determinants underlying banking-sector profitability.

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