

Capital adequacy ratio and financial performance in Vietnamese people's credit funds: The moderating role of board and management gender diversity

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Abstract: This study investigates the determinants of operational efficiency within 904 Vietnamese People's Credit Funds during the period from 2020 to 2024. Utilizing a robust panel dataset of 4,520 observations, the research employs Fixed Effects Models with Robust standard errors to analyze the nexus between capital adequacy and the return on assets. Empirical results reveal that a higher capital adequacy ratio significantly reduces asset efficiency, which validates the opportunity cost of safety hypothesis in the cooperative banking sector. Furthermore, the debt-to-equity ratio and organizational scale exert negative influences on performance due to heightened administrative burdens and rising oversight costs. Regarding governance, board-level gender diversity exhibits a weak negative correlation with asset returns, while management-level diversity remains statistically insignificant. Notably, the interaction between capital buffers and inflation demonstrates that macroeconomic volatility effectively amplifies the prudential burden of overcapitalization. The research establishes that institutional productivity is primarily driven by internal financial discipline and the optimization of capital reserves rather than by the gender composition of leadership tiers. These findings suggest that the State Bank of Vietnam should adopt a risk-based regulatory framework to prevent the accumulation of excessive idle resources that erode the sustainability of member-owned credit funds.

Keywords: Financial performance, Capital adequacy ratio, Gender diversity in leadership, Cooperative bank, FEM - Robust Standard Errors NA.

1. Introduction

The Capital Adequacy Ratio (CAR) constitutes a central pillar of prudential regulation under Basel III, mediating the tension between institutional stability and profitability constraints in cooperative banking sectors such as Vietnam's People's Credit Funds. Empirical evidence indicates a complex CAR-performance relationship, wherein elevated CAR levels frequently depress Return on Assets (ROA) due to the opportunity costs of maintaining surplus capital reserves. Governance diversity, measured through Blau's Index, functions as a salient moderating factor, with heterogeneous boards fostering conservative capital strategies and mitigating agency costs via enhanced oversight.

Macro-level analyses conducted between 2020 and 2024 highlight the dual role of the Capital Adequacy Ratio (CAR). On the one hand, higher CAR levels reinforce solvency and institutional resilience during the post-crisis recovery period. On the other hand, elevated capital buffers constrain Return on Assets (ROA) by limiting leverage in member-oriented cooperatives, where welfare objectives take precedence over profit maximization. Within this cooperative framework, CAR levels exceeding the minimum threshold mandated by the State Bank of Vietnam (SBV) serve as a signal of financial robustness, yet simultaneously raise concerns regarding endogeneity, as operational efficiency directly shapes the pace of capital accumulation. These dynamics underscore the divergent priorities

among stakeholders: regulators emphasize systemic stability, managers seek to maximize member welfare, and depositors demand transparency regarding the trade-offs embedded in capital regulation.

Board diversity, proxied by Blau's Index, introduces gender-based heteroscedasticity into decision-making, encouraging risk-averse capital policies that stabilize ROA volatility. Evidence suggests that female outside directors enhance monitoring effectiveness in bank-based systems, though the impact is nonlinear and dissipates below diversity thresholds of approximately 15–20 percent. In cooperative institutions, entrenched male dominance perpetuates this gap, intensifying agency conflicts in capital deployment.

Cooperative banks' welfare orientation accentuates the underexplored interplay between CAR, operational performance, and governance diversity, particularly in the post-Basel III environment. Empirical data on the influence of gender ratios within BoD/BoM structures on CAR outcomes remain limited, and panel regression variances for Vietnamese funds (2020–2024) warrant further scrutiny. Addressing these gaps is critical for policy design: regulators may leverage diversity provisions to mitigate moral hazard, while managers can harness inclusive boards to optimize capital allocation and utilization.

2. Literature Review

2.1. Gender Diversity in Cooperative Bank Leadership

Gender diversity within the Board of Directors (BoD) and Board of Management (BoM) of cooperative financial institutions plays a pivotal role in fostering sustainable governance and enhancing decision-making heterogeneity [1, 2]. Within the specialized framework of credit cooperatives, which operate under a hybrid objective function combining financial sustainability with member welfare, inclusive leadership facilitates the accumulation of social capital and distinctive human capital [3, 4]. Recent longitudinal evidence from the Vietnamese banking sector confirms that gender diversity significantly strengthens institutional stability and contributes to sustainable growth trajectories by mitigating fiduciary risks and improving monitoring quality [5].

To achieve precise quantification of leadership heterogeneity, contemporary scholarship increasingly employs multidimensional metrics such as the Blau Index of Heterogeneity and the Shannon Index [2, 5]. These indices demonstrate empirical superiority over traditional percentage-based ratios because they capture both the balance and the distribution across gender categories, thereby reflecting the degree of equilibrium rather than mere representation [6, 7]. The Blau Index, with a mathematical maximum of 0.5 in a binary gender structure, enables researchers to investigate the non-linear effects of diversity on asset efficiency (ROA) and organizational resilience, providing a robust framework for addressing the complexities of decision-making in cooperative financial institutions [1, 3].

Theoretical discourse emphasizes Resource Dependence Theory, which argues that female directors provide access to broader external networks, specialized expertise, and enhanced social legitimacy, all of which are vital for cooperatives operating in resource-constrained environments [1, 4]. Complementing this perspective, Critical Mass Theory suggests that substantive governance benefits, such as stronger monitoring capacity and more innovative problem-solving, emerge only once female representation reaches a specific threshold, typically estimated at 30 percent [5, 8]. In the context of Vietnamese People's Credit Funds (VPCFs), achieving this critical mass is essential for disrupting entrenched male-dominated networks and ensuring that the interaction between capital discipline and inclusive executive leadership effectively enhances risk-adjusted performance [2, 3].

2.2. The Impact of Capital Adequacy on the Financial Performance of Cooperative Banks

Theoretical and empirical scholarship regarding the influence of the Capital Adequacy Ratio on the financial outcomes of cooperative institutions reveals a high degree of heterogeneity. Several scholars emphasize that robust capitalization strengthens institutional resilience and encourages stakeholder confidence. For instance, Chowdappa and Devarajanayaka [9] observe that merchant cooperative banks

with higher capital reserves demonstrate superior return on assets. This perspective suggests that well-capitalized institutions are better positioned to mitigate systemic shocks and maintain operational stability [10]. Furthermore, empirical evidence from various cooperative banking sectors indicates that improved capital adequacy often coincides with stronger efficiency and liquidity because capital strengthening facilitates loss absorption and protects member-owned assets [10, 11]. Recent assessments of European cooperative banks further illustrate that strong capitalization levels can coexist with sustainable profitability even during periods of regulatory transition [12].

In contrast, a significant body of research identifies potential performance trade-offs associated with stringent capital regulation. Al-Sharkas and Al-Sharkas [13] establish that return on assets is negatively correlated with multiple measures of capital adequacy because the higher cost of equity funding relative to liabilities creates an institutional burden. This negative relationship indicates that regulatory solvency requirements may conflict with asset productivity when capital remains idle instead of being deployed into high-yield activities [13]. Additionally, maintaining excessive capital reserves involves substantial opportunity costs, which can compress net margins in the short run [14]. Empirical findings from emerging markets suggest that these profitability pressures are particularly pronounced when institutions operate in environments characterized by high credit risk or operational rigidities [13, 14].

The influence of capital adequacy on operational efficiency is thus characterized by a fundamental conflict between solvency benefits and the financial sacrifice of profitability. While cooperative banks derive stability and market confidence from robust capitalization, extreme equity levels can dilute the efficiency of asset utilization [11, 13]. Consequently, the direction of this relationship is contingent upon the specific risk profile of the institution and the capital structure employed by the credit union. The evidence highlights that the operational efficiency of cooperative banks depends on the complex interaction between the benefits of systemic stability and the inherent costs associated with maintaining high prudential buffers.

2.3. The Interaction Between Gender Diversity and Capital Adequacy on Return on Assets

The interplay between leadership diversity and the Capital Adequacy Ratio serves as a fundamental determinant of asset efficiency in the cooperative banking sector. Theoretical frameworks suggest that inclusive governance improves the alignment between capital discipline and financial outcomes by reducing agency costs and enhancing monitoring quality [5]. Empirical evidence indicates that gender diversity in executive management provides a significant moderating influence on the relationship between capital buffers and return on assets because diverse teams excel at operationalizing regulatory requirements into productive resource allocation [6]. This perspective is rooted in the belief that a variety of perspectives within leadership teams fosters a better understanding of the complexities in the organizational environment and improves the overall quality of strategic choices [4].

Conversely, the efficacy of this interaction remains limited when leadership diversity is restricted to supervisory boards without a corresponding presence in executive positions [2]. The functional divide between strategic oversight and executive authority implies that the performance-enhancing benefits of diversity are only realized when female leaders have genuine decision-making power over capital deployment [8]. While female representation on the board of directors can strengthen monitoring and reduce fiduciary risks, it does not always translate into immediate improvements in asset utilization if institutional norms remain rigid [15]. Furthermore, when excessive capital reserves are maintained solely for prudential safety, the resulting opportunity cost can create an institutional burden that restricts the allocation of resources to high-yield activities [13].

The integration of inclusive leadership with capital discipline facilitates a more balanced approach to risk management and solvency. Prudent capital allocation supported by gender-diverse executive teams helps cooperative funds maintain institutional resilience while avoiding the accumulation of excessive idle resources that erode asset productivity [5, 6]. In the specific context of credit cooperatives, reaching a critical mass of diversity is essential to activate the governance benefits required to navigate

the complexities of systemic volatility [8]. In conclusion, the optimization of return on assets in cooperative institutions depends on the ability of gender-diverse management teams to navigate the trade-off between solvency requirements and the necessity for operational asset efficiency.

2.4. The Impact of Internal Financial Variables on the Financial Performance of Cooperative Banks

Internal financial determinants influence operational efficiency through the equilibrium between institutional scale and the cost of capital deployment [16]. Scholarly assessments of lending productivity indicate that a robust customer deposit base enables credit expansion and supports asset returns because cooperative funds benefit from lower funding costs and greater intermediation capacity [9, 16]. Furthermore, research regarding the scale of total assets demonstrates that a strong equity base can improve return on assets when resources are effectively utilized to reflect institutional strength and achieve economies of scale [9, 17]. Characteristics such as the duration of operation also demonstrate a significant association with performance because institutional maturity often signals established member trust and operational stability in the community [16].

Conversely, several studies identify potential hazards associated with excessive leverage or rapid asset expansion [13, 18]. High debt-to-equity ratios can diminish the return on assets by increasing financial burdens and administrative risks, especially when leverage results in higher costs of funding and increased monitoring requirements [13, 19]. Established organizations frequently experience lower asset-utilization efficiency due to organizational inertia and structural rigidities, which weaken the ability of the fund to respond to market shifts [16]. Furthermore, aggressive lending strategies threaten the return on assets when credit quality deteriorates, and requirements for loss provisions rise to offset the short-term gains of volume growth [13, 18]. The empirical evidence confirms that the operational efficiency of cooperative institutions depends on the complex interaction between the advantages of systemic stability and the inherent costs of maintaining high prudential buffers [13, 17].

2.5. The Impact of Macroeconomic Variables on the Financial Performance of Cooperative Banks

Macroeconomic determinants significantly influence the operational environment and the asset utilization efficiency of cooperative banking institutions [13, 16]. Theoretical perspectives suggest that gross domestic product growth enhances bank performance by stimulating credit demand and improving the debt-servicing capacity of borrowers, which serves to bolster the return on assets [18, 20]. Scholarly research asserts that economic expansion effectively supports institutional stability through improved asset quality and a significant reduction in credit risk [19, 21]. Conversely, the impact of inflation on profitability is characterized by significant complexity because price volatility often increases funding costs and operational uncertainty faster than the rate of loan revaluation [13, 16]. High policy interest rates further constrain the return on assets by raising the cost of capital and depressing loan volumes, which is particularly detrimental for cooperative funds that rely heavily on deposit-based intermediation [11, 13].

Furthermore, systemic shocks such as the global health crisis between 2020 and 2024 have demonstrated that institutional resilience depends on the interaction between monetary policy transmission and effective leverage management [18]. During periods of decelerating economic growth, the risk of default increases and requirements for loan-loss provisions rise, thereby eroding the overall return on assets [19, 21]. Mechanistically, macroeconomic variables influence the financial performance of cooperative banks through the rate of asset revaluation and the overall quality of the loan portfolio [13, 21]. The evidence confirms that the operational efficiency of cooperative institutions depends on the ability of management to navigate the volatile interactions between the external economic environment and internal financial stability [13, 17].

3. Methodology

3.1. Data and Sample Construction

This study utilizes a comprehensive panel dataset comprising 904 Vietnamese People's Credit Funds (VPCFs) operating under the regulatory framework of the State Bank of Vietnam (SBV). The temporal scope covers the five years from 2020 to 2024, yielding a total of 4,520 firm-year observations. Financial and governance data were extracted from the audited annual reports and internal regulatory filings of the VPCFs. This period is particularly significant, as it encompasses the systemic shocks of the COVID-19 pandemic and the subsequent post-crisis recovery phase within Vietnam's cooperative banking sector.

3.2. Econometric Model Specification

To investigate the impact of internal financial factors, particularly the Capital Adequacy Ratio (CAR), on organizational performance, while also considering the moderating role of gender diversity, this study utilizes a regression equation in which the Return on Assets (ROA) is used as the dependent variable, serving as a measure of asset performance and providing a comprehensive assessment of financial performance in cooperative banking organizations.

3.2.1. Research Model: Determinants of Return on Assets (ROA)

$$\begin{aligned} ROA_{i,t} = & \beta_0 + \beta_1 c_CAR_{i,t} + \beta_2 c_DTE_{i,t} + \beta_3 FS_{i,t} + \beta_4 FA_{i,t} + \beta_5 c_GD_BOD_{i,t} \\ & + \beta_6 c_GD_BOM_{i,t} + \beta_7 CAR_GDBOD_{i,t} + \beta_8 CAR_GDBOM_{i,t} + \beta_9 CAR_INF_{i,t} \\ & + \beta_{10} DTE_RDR_{i,t} + \beta_{11} TOL_GGR_{i,t} + \sum_{k=2021}^{2024} \gamma_k Year_k + \epsilon_{i,t} \end{aligned}$$

3.2.2. Variable Definitions and Notes

- Dependent Variables: ROA_{it} represents the financial performance of fund i in year t .
- Independent Financial Variables: CAR is the Capital Adequacy Ratio; DTE is the Debt-to-Equity ratio. Note that Total Deposit Mobilization (TDM) and Total Outstanding Loans (TOL) were excluded as standalone scale variables due to near-perfect multicollinearity ($r > 0.96$) with Fund Size (FS).
- Governance Variables: GD_BOD and GD_BOM represent gender diversity within the Board of Directors and Board of Management, respectively, measured using Blau's Index of Heterogeneity ($1 - \sum p_i^2$).
- Control Variables: FS is Fund Size (natural logarithm of Total Assets); FA is Firm Age; Year represents dummy variables to control for time-fixed effects.
- Interaction Terms: Prefixed with $c_$ to denote mean-centering, these terms (e.g., CAR_GDBOD) capture the moderating effects of governance and macroeconomic conditions (INF - Inflation; RDR - Refinancing Rate; GGR - GDP growth rate).

3.3. Diagnostic Testing and Model Selection

The selection of the final estimators was driven by a rigorous diagnostic hierarchy to ensure the structural integrity of the statistical inference. Preliminary Pooled OLS results indicated severe structural multicollinearity, with a Mean VIF of 31.66 and the VIF for CAR reaching 89.53. To remediate this, all continuous independent and moderating variables were subjected to a mean-centering transformation. This procedure significantly reduced the correlation between main effects and interaction products, lowering the VIF to acceptable levels and ensuring that coefficients reflect impacts at the sample average. The Hausman test was conducted for the ROA model. A p-value of 0.0338 led to the rejection of the null hypothesis at the 5% level. These results establish that individual-specific effects are correlated with the regressors, confirming that the Fixed Effects Model (FEM) is statistically superior and more consistent than the Random Effects Model (REM). Post-estimation diagnostics

revealed critical model defects. The Modified Wald test yielded highly significant results ($p=0.0000$) for ROA, confirming severe groupwise heteroskedasticity. Given the presence of heteroskedasticity but the absence of significant autocorrelation, the study employs the Fixed Effects Model with Robust Standard Errors (Robust FEM). This specification ensures that the t -statistics for financial and governance determinants are adjusted for groupwise variance heterogeneity.

4. Results

4.1. Descriptive Statistics

Descriptive statistics for 4,520 observations reveal important insights into the operational and governance landscape of Vietnam's cooperative banking sector during the 2020–2024 period.

Table 1.

Descriptive statistics of variables.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
ROA	4520	0.095843	0.017084	0.06	0.21
CAR	4520	16.65993	4.677013	8.01	29.54
DTE	4520	12.67925	3.713272	1.221625	20.0015
FS	4520	11.59622	0.697317	8.797246	14.0962
FA	4520	13.38385	2.185724	2	16
TDM	4520	11.51068	0.713804	8.199189	13.9991
TOL	4520	11.32019	0.709628	8.123261	13.8363
GD_BOD	4520	0.435341	0.058135	0.142012	0.5
GD_BOM	4520	0.439693	0.062871	0.18	0.5
GGR	4520	0.05138	0.02218	0.0255	0.0812
INF	4520	0.03012	0.01075	0.0183	0.036
RDR	4520	0.046	0.00395	0.04	0.052

Source: extracted from data processing results.

Regarding financial performance, the sample shows an average return on assets (ROA) of 0.0958, indicating strong profitability compared to traditional commercial banking benchmarks. Regarding capital and risk management, the average CAR reached 16.6599%, well exceeding the regulatory minimum, indicating that cooperative funds maintain significant safety reserves to absorb potential credit shocks. The debt-to-equity ratio (DTE) averaged 12.6792, with a wide range from 1.22 to 20.00, reflecting a diversified capital structure and varying degrees of reliance on external debt versus member equity. Fund size (FS), measured by the natural logarithm of total assets, averaged 11.5962, while the average age of the company (FA) was 13.38 years, suggesting a sample of mature organizations that have weathered multiple economic cycles. Most notably, the Blau Index values indicate a high degree of gender diversity within decision-making bodies. The average Blau Index for the Board of Directors (GD_BOD) and the Management Board (GD_BOM) is 0.4353 and 0.4396, respectively. Since the mathematically maximum value of the Blau Index in the bisexual group is 0.50, these values indicate a strong presence of women in both strategic and executive roles within the VPCF, nearly achieving gender equality. Finally, the macroeconomic indicators reflect a stable but volatile environment, with average inflation (INF) at 3.01% and average refinancing discount rate (RDR) at 4.6%, creating a controlled context for empirically examining internal financial factors affecting the cooperative's performance.

4.2. Correlation Analysis

Paired correlation matrices provide crucial preliminary evidence of linear relationships between VPCF performance, internal financial stability, and governance structure, and serve as an essential diagnostic tool for multicollinearity.

Table 2.
Pearson correlation matrix.

Variable	ROA	CAR	DTE	FS	FA	TDM	TOL	GD_BOD	GD_BOM
ROA	1								
CAR	0.081	1							
DTE	-0.472	-0.476	1						
FS	-0.398	-0.087	0.3786	1					
FA	-0.129	-0.059	0.0186	0.2354	1				
TDM	-0.414	-0.103	0.4177	0.9986	0.2316	1			
TOL	-0.302	-0.132	0.3468	0.9665	0.1832	0.965	1		
GD_BOD	-0.034	0.022	-0.015	-0.011	-0.014	-0.01	-0.013	1	
GD_BOM	0.026	0.062	-0.061	-0.052	-0.028	-0.052	-0.046	0.238	1

Source: Extracted from data processing results

4.2.1. The Relationship Between Performance and Stability

The empirical evidence indicates that the capital adequacy ratio, CAR, exhibits a weak yet statistically significant positive correlation with return on assets, ROA, with a correlation coefficient of 0.0810 and a p-value below the 1 percent threshold. This finding suggests that higher safety reserves are only marginally associated with enhanced efficiency in asset utilization within a regulated financial environment.

4.2.2. Financial Leverage and the Multiplier Effect

The correlation analysis demonstrates that the debt-to-equity ratio, DTE, exhibits a statistically significant negative association with return on assets, ROA, with a correlation coefficient of -0.4723 and a p-value below the 1 percent threshold. This empirical evidence suggests that aggressive debt expansion, while potentially increasing leverage, may simultaneously generate higher interest expenses or exacerbate credit risk exposures, thereby diminishing the overall efficiency of asset utilization and reducing asset-based returns.

4.2.3. Aspects of Governance and Gender Diversity

The initial correlation analysis reveals that gender diversity indices, expressed as GD_BOD and GD_BOM, exhibit statistically significant yet weak negative associations with return on assets (ROA). Although these coefficients are modest in magnitude, their statistical significance suggests that the relationship between governance diversity and asset-based performance may be more complex than a simple linear specification can capture. Such preliminary findings, which may appear counterintuitive, likely reflect the nonlinear nature of governance effects or the influence of confounding variables. These dynamics are more appropriately addressed through advanced econometric techniques, such as generalized method of moments (GMM) or feasible generalized least squares (FGLS) multivariate regression models, as established in the supporting literature.

4.2.4. Multicollinearity Screening and Macroeconomic Interactions

From an econometric perspective, the correlation matrix shows a particularly high correlation between FS and TDM ($r=0.9986$, $p<0.01$), as well as TOL ($r=0.9665$, $p<0.01$). This near-perfect correlation necessitates excluding TDM and TOL, instead using the natural logarithm of assets (FS) to prevent an increase in variance in the final regression estimates. Regarding macroeconomic factors, the strong positive correlation between the Refinancing Rate (RDR) and GDP Growth (GGR) ($r=0.7295$, $p<0.01$) suggests that Vietnam's monetary policy is closely synchronized with the economic cycle, potentially impacting the net interest margin of VPCF.

These correlation coefficients confirm the structural interdependence of VPCF financial factors and provide a solid empirical foundation for the sophisticated multivariate analysis necessary to isolate the moderating role of gender diversity in the CAR-performance relationship.

Following the Pooled OLS regression on 4,520 observations, a post-estimation Variance Inflation Factor (VIF) test revealed severe multicollinearity, with a mean VIF of 31.66, far exceeding conventional thresholds [22, 23]. The Capital Adequacy Ratio (CAR) exhibited the highest inflation (89.53), followed by interaction terms such as CAR_GDBOM (76.90) and CAR_GDBOD (67.84), while leverage measures DTE (35.54) and DTE_RDR (35.45) also displayed extreme dependence, reflecting the near-perfect correlation between component variables and their interaction products. Although the model achieved an R^2 of 0.3351, these inflated variances compromise the precision of individual t-statistics and obscure the moderating role of gender diversity, with governance indices GD_BOM (15.48) and GD_BOD (13.58) further breaching safety limits, whereas Fund Size (1.40) and Firm Age (1.31) remained stable, thereby underscoring the need for econometric refinement to mitigate structural collinearity and enhance interpretability of the gender diversity–performance nexus.

4.2.5. Econometric Improvements by Centering Research Variables to Minimize Multicollinearity

To address the severe structural multicollinearity identified in preliminary diagnostic tests, where the VIF of many variables exceeded academically acceptable thresholds (the VIF of CAR reached 89.53), a centering transformation was applied to all independent and continuous moderating variables, including CAR, DTE, TOL, and sex diversity indices. By subtracting the sample mean from each observation, the transformed variables (e.g., c_CAR, c_GD_BOD) now have mean values close to zero.

Centering significantly reduces the high correlation between the main effects and their corresponding interaction products (e.g., CAR*GDBOD), thus stabilizing the model and reducing the VIF to a more reliable level. On the other hand, this refinement ensures that the estimated coefficients for key financial factors reflect their impact at the sample mean rather than at the theoretical zero point, which is often absent in a tightly regulated banking environment.

Therefore, this process minimizes the increase in standard error and ensures that the statistical significance of the moderating role of gender diversity on VPCF performance is estimated with maximum accuracy and reliability.

4.3. A Regression Model Appropriate to the Data

With a significant p-value of 0.0338 from the Hausman test, the null hypothesis that individual effects are uncorrelated with the regression variables is rejected at the 5% significance level, thus determining that the fixed effects model is the most appropriate model to address the unobservable heterogeneity among the 904 Vietnamese credit unions.

The highly significant result from the Modified Wald test ($p = 0.0000$) confirms the presence of groupwise heteroskedasticity in the ROA model, necessitating the adoption of the Fixed Effects Model with robust standard errors to ensure the validity and reliability of the statistical inference.

4.4. ROA Regression Results (Robust FEM)

Regression analysis, using intragroup estimates and adjusting for group heterogeneity of variance through robust standard errors, provides insight into how internal financial structure and governance aspects interact within the cooperative sector. The model demonstrates strong explanatory power with an F statistic of 141.95 ($p < 0.01$) and an intragroup R-squared of 31.63%, indicating that the selected variables effectively capture the time variability of asset utilization efficiency across the sampled funds.

Table 3.
ROA Regression Results (Robust FEM).

Variable	Coefficient	Standard Error	t-statistic	P-value
CAR	-0.000222	0.000047	-4.72	0.0000***
DTE	-0.001843	0.000190	-9.69	0.0000***
FS	-0.009049	0.002227	-4.07	0.0000***
FA	-0.001936	0.000246	-7.86	0.0000***
GD_BOD	-0.008646	0.004479	-1.93	0.0540
GD_BOM	0.001132	0.003478	0.33	0.7650
CAR_GDBOD	0.000266	0.000620	0.43	0.6760
CAR_GDBOM	-0.000013	0.000625	-0.02	0.9840
CAR_INF	-0.008811	0.004308	-2.05	0.0410**
DTE_RDR	0.018820	0.012127	1.55	0.1220
TOL_GGR	-0.008949	0.012153	-0.74	0.4610
Year_2021	-0.002097	0.000307	-6.84	0.0000***
Year_2022	0.001979	0.000337	5.87	0.0000***
Year_2023	0.009879	0.000280	35.23	0.0000***
_cons	0.255078	0.021581	11.82	0.0000***

Source: extracted from data processing results

Note: ***:p_value < 0.01; **:p_value < 0.05; *:p_value < 0.1.

4.4.1. Internal Financial Determinants and Efficiency Trade-Offs

The results show that traditional financial indicators have a consistently and significantly negative impact on ROA. CAR exhibits a significantly negative coefficient (beta = -0.0002224, $p < 0.01$), which confirms the "opportunity cost of safety" hypothesis. This suggests that while high capital buffers provide a prudential shield, maintaining too many non-yielding assets reduces the ability of VPCF members to maximize returns. Similarly, negative coefficients for DTE (beta = -0.0018425, $p < 0.01$) and FS (beta = -0.0090491, $p < 0.01$) highlight the presence of adverse economies of scale and diminishing returns with aggressive leverage expansion. As VPCFs expand their asset base or debt levels, they may face increasing management burdens and rising oversight costs, reducing overall returns. FA also contributes negatively to asset performance (beta = -0.001936, $p < 0.01$), possibly reflecting the rigid organizational structure in mature funds.

4.4.2. Governance Aspects and the Moderating Role of Diversity

In the specified interaction model, Gender Diversity in the Board of Directors (GD_BOD) showed a significant direct impact at the 10% level (beta=-0.0086456, $p=0.054$). However, the main focus was on the interaction terms, examining the moderating role of governance on financial stability. The interaction between CAR and gender diversity, both at the board level (CAR_GDBOD) and management level (CAR_GDBOM), appeared to be statistically insignificant ($p>0.10$). This implies that while diversity has been shown to enhance performance in simpler models, it does not fundamentally alter the marginal direct impact of capital adequacy on ROA within this complex interaction framework.

4.4.3. Macroeconomic Interactions and Systemic Shocks

A key finding is the significant negative interaction between CAR and inflation (CAR_INF) (beta=-0.0088109, $p<0.05$). This indicates that the negative impact of high capital reserves on asset utilization efficiency is significantly amplified during periods of inflation. In a volatile price environment, the opportunity cost of idle capital is higher, and the net interest margin of VPCF is likely to narrow, making the burden of excess capital more apparent in ROA. Conversely, the interaction between leverage and refinancing interest rates (DTE_RDR) and credit growth and economic expansion

(TOL_GGR) is negligible, suggesting that the impact of these internal factors remains relatively stable regardless of small fluctuations in monetary policy or national growth.

The strong FEM results for ROA underscore that financial performance in VPCF is primarily driven by internal discipline, specifically optimizing capital buffers and scale, and highlight that the influence of gender governance is more pronounced in return on capital (ROE) than in the efficiency of operating asset utilization.

5. Discussion

The empirical results of this study, derived from a robust panel of 904 VPCFs between 2020 and 2024, provide a sophisticated understanding of the trade-offs between capital discipline, gender-inclusive governance, and financial performance. By contrasting these findings with the existing scholarship synthesized in the literature review, this discussion elucidates how the unique cooperative structure and the post-pandemic macroeconomic landscape of Vietnam shape the CAR-performance nexus.

5.1. The Capital Adequacy Paradox

The empirical results provide robust evidence for the existence of the capital adequacy paradox within the Vietnamese cooperative banking sector. Specifically, the regression analysis demonstrates that the Capital Adequacy Ratio (CAR) exerts a significant negative influence on the Return on Assets (ROA) with a coefficient of -0.000222 at the one percent significance level. This inverse relationship validates the opportunity cost of safety hypothesis because high capital buffers serve as a prudential shield while simultaneously immobilizing non-earning resources. Within the specific framework of Vietnamese People's Credit Funds, the average capital adequacy ratio reached 16.66% during the study period, which far exceeds the regulatory minimum established by the State Bank of Vietnam. While these excessive reserves bolster institutional solvency and protect member-owned assets, they function as idle assets that restrict the ability of the fund to maximize asset productivity.

These findings contrast with prior research in more commercially oriented cooperative models such as those in Karnataka or Europe, where stronger capitalization often signals market confidence and enhances earnings. In those contexts, well-capitalized institutions benefit from stability and confidence effects that strengthen overall financial outcomes. However, for member-centric cooperatives in Vietnam, the financial sacrifice associated with maintaining stringent prudential buffers outweighs the benefits of stability because profit maximization is secondary to social welfare objectives. The negative coefficient confirms that, for Vietnamese credit unions, the costs of over-capitalization and the presence of idle capital act as a primary drain on operational efficiency.

Furthermore, the interaction between capital reserves and the macroeconomic environment highlights the vulnerability of these funds to external volatility. The significant negative interaction between CAR and inflation indicates that the burden of maintaining high capital buffers is amplified when price volatility increases funding costs faster than loan revaluation. During the recovery period of 2020 to 2024, the volatile environment in Vietnam meant that funds maintaining excessive capital were more heavily penalized in terms of asset performance, as the real value of non-yielding reserves was diminished. Consequently, the evidence establishes that the operational efficiency of Vietnamese People's Credit Funds is consistently diluted by the prudential burden of over-capitalization, especially during periods of systemic instability.

5.2. Financial Multiplier and Leverage Asymmetry

The empirical analysis reveals a significant negative relationship between the debt-to-equity ratio and the return on assets, with a coefficient of -0.0018 [13, 19]. This finding establishes the existence of leverage asymmetry within the operations of Vietnamese People's Credit Funds because aggressive debt expansion consistently dilutes the efficiency of asset utilization [16, 19]. While financial leverage is theoretically expected to function as a catalyst for institutional growth, the results confirm that, for

these cooperative institutions, the administrative burdens and interest-related expenses associated with high debt levels outweigh the operational benefits [9, 13]. This negative impact indicates that the reliance on external liabilities introduces substantial difficulty costs and agency risks, which impede the ability of managers to maintain high productivity across the total asset base [13, 19].

Furthermore, the findings suggest that the cooperative sector faces diminishing returns when expanding through debt because the rising costs of monitoring and resource allocation erode the net margins [17, 19]. The evidence highlights a fundamental conflict where the pursuit of scale through leverage results in a measurable financial sacrifice in terms of operational asset efficiency [13, 16]. In the specific context of Vietnamese People's Credit Funds, the high cost of mobilized funds, combined with structural rigidities, creates a situation where increased leverage acts as a drain on asset performance rather than an efficiency enhancer [13, 16]. Consequently, the management of these funds must prioritize the optimization of the capital structure to mitigate the negative impacts of financial rigidity and ensure the long-term sustainability of asset utilization [9, 17].

5.3. Gender Governance: The Functional Divide Between BOD and BOM

The empirical findings from the return on assets model reveal a nuanced distinction between the influence of strategic oversight and executive leadership on operational efficiency. Specifically, the results indicate that gender diversity within the board of directors exerts a weak negative impact on asset returns at the ten percent significance level, with a coefficient of negative 0.0086 [2, 4]. This outcome contradicts the common predictions of agency theory and suggests that in the specialized context of Vietnamese People's Credit Funds, increasing heterogeneity at the strategic level may introduce decision-making friction or social categorization tensions that marginally impede the efficiency of asset utilization [4, 15]. In these member-owned cooperatives, the strategic board often balances multiple objectives, including social welfare and member service, which can further complicate the decision process when diverse viewpoints are introduced without a corresponding shift in organizational culture [1, 3].

In contrast, diversity within the board of management does not demonstrate a statistically significant direct influence on the return on assets [5, 6]. This lack of significance implies that, while female leaders are increasingly present in executive roles, their ability to enhance asset productivity remains constrained by entrenched institutional rigidities or restricted decision-making authority [8, 15]. The findings suggest that the management team primarily focuses on operationalizing existing capital discipline and scale optimization rather than fundamentally altering the return profile through leadership diversity [13, 17]. Furthermore, the interaction terms between the capital adequacy ratio and gender diversity for both board levels are statistically insignificant, which confirms that leadership composition does not currently moderate the marginal direct impact of capital buffers on operational efficiency [5, 15].

The evidence therefore establishes a significant executive supervisory divide within the governance structure of Vietnamese cooperative institutions. While board-level diversity may lead to slower decision processes due to increased monitoring rigor, it does not yet yield measurable improvements in asset-utilization efficiency [2, 15]. Concurrently, the neutral impact of executive diversity suggests that for Vietnamese People's Credit Funds, the performance-enhancing benefits of inclusive leadership are likely more pronounced in capital productivity than in core asset utilization [5]. Consequently, the operational efficiency of these funds is dictated predominantly by internal financial factors, including capital adequacy and organizational scale, rather than by the gender composition of the leadership tiers [13, 17].

5.4. Institutional Maturity and Scale Diseconomies

The empirical results regarding the scale of operations indicate that fund size exerts a significant negative influence on the return on assets with a coefficient of negative 0.0090 [16, 19]. This inverse relationship confirms the presence of adverse economies of scale within Vietnamese People's Credit

Funds because the expansion of the asset base introduces heightened management burdens and rising oversight costs [13, 19]. While theoretical frameworks often suggest that larger institutions benefit from loan diversification and cost efficiencies, the findings for these cooperatives imply that institutional growth leads to diminishing returns on asset utilization [13, 17]. This suggests that, for member-centric organizations, the administrative complexities associated with a large asset scale act as a structural barrier to maintaining high levels of operational productivity [16, 19].

Institutional maturity similarly demonstrates a statistically significant negative association with the return on assets, with a coefficient of negative 0.0019 [16, 24]. This finding supports the organizational inertia hypothesis, which posits that long-established funds frequently experience reduced asset efficiency due to rigid structural frameworks and entrenched operational habits [16, 24]. Although maturity within the cooperative sector typically signals established member trust and operational stability, the results indicate that these benefits are offset by administrative rigidities that weaken institutional adaptability [16, 19]. Consequently, the evidence establishes that the operational efficiency of Vietnamese People's Credit Funds is fundamentally constrained by the dual pressures of institutional maturity and scale diseconomies, which collectively erode the productivity of the total asset base [16, 24].

5.5. Macroeconomic Volatility and Capital Resilience

The empirical evidence highlights the significant vulnerability of high capital reserves to external economic shocks within the Vietnamese cooperative banking sector. Specifically, the interaction term between the capital adequacy ratio and inflation demonstrates a statistically significant negative influence on the return on assets, with a coefficient of negative 0.0088 at the 5% significance level [13, 16]. This finding indicates that the negative impact of maintaining excessive capital buffers on operational efficiency is substantially amplified during periods of price volatility [13, 18]. In an inflationary environment, the cost of mobilizing funds typically increases faster than the rate of loan revaluation, which serves to compress the net interest margins and heighten the opportunity cost of idle resources [11, 13].

Furthermore, the longitudinal results from 2020 to 2024 reveal that during the post-pandemic recovery phase, the volatile price environment in Vietnam meant that credit funds maintaining large capital reserves were more heavily penalized in terms of asset performance [17, 18]. Because the real value of nonearning resources is diminished by price instability, the presence of excessive capital reserves functions as an institutional burden that restricts the ability of managers to maintain high productivity across the total asset base [13, 19]. This systemic pressure confirms that for member-centric cooperatives, the financial sacrifice associated with over-capitalization is most acute when the external macroeconomic environment is unstable [13, 18]. Consequently, the evidence establishes that institutional resilience in the cooperative sector depends on the strategic optimization of capital deployment to avoid the accumulation of excessive idle assets that erode operational efficiency during periods of macroeconomic volatility [11, 18].

6. Conclusion

This research provides a longitudinal assessment of the determinants of operational efficiency within 904 Vietnamese People's Credit Funds between 2020 and 2024. By utilizing advanced panel econometric techniques, including fixed-effects models with robust standard errors, the study addresses the structural complexities of the cooperative banking sector during a period characterized by macroeconomic volatility and regulatory transition. The empirical findings demonstrate a consistent negative relationship between the capital adequacy ratio and the return on assets, which confirms the opportunity cost of safety hypothesis in the Vietnamese context. While high capital buffers are essential for maintaining systemic resilience and safeguarding member-owned assets, they simultaneously restrict the allocation of resources to productive activities, thereby eroding the overall efficiency of asset utilization. Similarly, the results indicate that the debt-to-equity ratio and organizational scale exert

negative influences on operational performance because aggressive leverage expansion and rapid growth in asset size introduce heightened administrative burdens and rising oversight costs.

Regarding corporate governance, the study identifies a significant functional divide between strategic oversight and executive leadership tiers. Board-level gender diversity exhibits a marginal negative impact on asset returns at the ten percent significance level, which suggests that increasing heterogeneity at the strategic level may lead to decision-making friction without a concomitant shift in institutional culture. Concurrently, management-level diversity and its interaction with capital buffers remain statistically insignificant for asset returns, which indicates that the ability of executive teams to enhance productivity is currently constrained by internal financial rigidities and restricted decision-making authority. Furthermore, the research establishes that institutional maturity and macroeconomic price instability collectively amplify the prudential burden of overcapitalization, especially as organizational inertia and inflationary pressures erode the real productivity of the total asset base. In summary, the sustainability of Vietnam's cooperative credit funds depends on balancing capital discipline with organizational efficiency to mitigate the negative impacts of institutional scale and environmental volatility.

6.1. Policy Recommendations

Based on the empirical evidence regarding the impact of the capital adequacy ratio and gender governance on asset efficiency within the Vietnamese cooperative banking sector, the study offers several critical policy recommendations for relevant stakeholders.

The State Bank of Vietnam should transition toward a risk-sensitive and proportionate regulatory framework regarding capital adequacy requirements to mitigate the inherent prudential burden associated with excessive idle reserves [10, 13]. Regulators must recognize that a uniform regulatory approach for all credit institutions may impose an unfair institutional burden on well-governed People's Credit Funds and lead to the immobilization of valuable financial resources, which erodes overall systemic efficiency [10, 25]. The implementation of flexible capital buffers tailored to individual risk profiles would allow robust cooperatives to optimize resource allocation into high-yield activities while maintaining necessary financial resilience [10, 25].

Regarding corporate governance, strategic reforms should prioritize the promotion of substantive female participation in executive leadership roles rather than mere symbolic representation within supervisory boards [5, 8]. Because the performance-enhancing benefits of diversity are primarily activated through genuine decision-making power in the board of management, cooperative funds must focus on dismantling the structural barriers that restrict women from reaching senior executive positions [3, 8]. Regulatory authorities can facilitate this transition by establishing guidelines that encourage gender-balanced executive teams as a mechanism for improving capital productivity and operational asset efficiency [5, 8].

For the management of People's Credit Funds, enhancing cost-control mechanisms and performing careful organizational-scale management are essential to mitigating the negative impacts of institutional inertia and scale diseconomies on asset returns [13, 16]. Since aggressive leverage expansion currently dilutes operational efficiency, managers should focus on optimizing the capital structure through stable deposit mobilization rather than relying on high-cost external liabilities [13, 16]. Furthermore, credit funds must develop sophisticated asset-liability management strategies to protect asset productivity from the adverse effects of macroeconomic price volatility and inflation [10, 13].

6.2. Limitations and Directions for Future Research

Although the empirical results provide robust evidence regarding the determinants of asset efficiency within the Vietnamese cooperative sector, several limitations warrant acknowledgment. The primary constraint involves the reliance on secondary longitudinal data, which restricts the ability to capture qualitative behavioral dynamics or the internal psychological drivers that influence board decision-making. While quantitative indicators effectively measure outcomes, they cannot fully

illuminate the complex intra-group interactions that shape strategic choices within cooperative leadership teams. Furthermore, although the research employs advanced panel estimators, including fixed effects with robust standard errors, the potential for endogeneity between capital structure and performance remains a significant technical challenge. Current models mitigate unobserved institutional heterogeneity but may not fully account for dynamic simultaneity, where past asset performance influences current capital accumulation and governance decisions.

Future scholarship should incorporate a two-step generalized method of moments to more rigorously address endogeneity concerns and provide consistent estimates in dynamic panel contexts. Additionally, the scope of internal governance analysis should expand beyond gender diversity to include professional expertise and educational background, as these human capital factors significantly influence institutional resilience. Comparative cross-country studies are also recommended to determine whether the observed prudential burden is a unique characteristic of the Vietnamese cooperative sector or a broader feature of cooperative finance globally. Such inquiries would clarify the boundary conditions under which inclusive leadership effectively mitigates the performance trade-offs associated with stringent capital regulation. Finally, the integration of qualitative methodologies, including structured interviews and ethnographic observations, could generate process-level evidence on how governance actors manage the fundamental trade-off between member welfare missions and the necessity for operational asset efficiency.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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