

Determinants of Financial Performance in Algerian Banks: A Dynamic Panel Data Analysis Using System-GMM

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Abstract

This study examines the determinants of financial performance in Algerian commercial banks using a comprehensive dataset spanning 2015-2024. Employing a two-step system-GMM estimator on a balanced panel of 18 banks (180 bank-year observations), we investigate the impact of bank-specific and macroeconomic factors on Return on Assets (ROA) and Return on Equity (ROE). Our robust specification tests confirm instrument validity and absence of serial correlation concerns. Results reveal that credit risk (NPL ratio) exerts the strongest negative impact on bank performance, while net interest margin emerges as the most significant positive determinant. Capital adequacy demonstrates differential effects: improving ROA while reducing ROE, indicating a leverage-safety trade-off. Private banks consistently outperform public institutions across both performance metrics.

Keywords: Banking performance, System-GMM, Credit risk, Operational efficiency, Algeria, Financial intermediation

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1. Introduction

The banking sector serves as the cornerstone of financial intermediation and monetary transmission in emerging economies. In Algeria, where the financial system remains predominantly bank-centered, understanding the determinants of banking performance carries particular significance for economic stability and growth prospects. The Algerian banking landscape has undergone substantial transformation since the 1990s financial liberalization, yet performance disparities between institutions persist, warranting systematic investigation.

Recent global financial disruptions, including the COVID-19 pandemic and oil price volatility, have heightened interest in identifying robust performance drivers within banking systems of resource-dependent economies. Algeria's unique position as an oil-exporting nation with a dual ownership structure (public and private banks) provides an ideal laboratory for examining these dynamics.

This study contributes to the literature in several dimensions. First, we employ dynamic panel methodology (system-GMM) to address endogeneity concerns and performance persistence effects that plague traditional estimation approaches (Athanasoglou & et al, 2008, p. 121). Second, we provide comprehensive diagnostic validation including serial correlation tests, instrument validity assessments, and robustness checks across multiple estimators. Third, we integrate detailed analysis of ownership effects and temporal dynamics, particularly during crisis periods. Finally, we translate empirical findings into actionable managerial and supervisory recommendations aligned with contemporary banking challenges.

Our analysis reveals a clear hierarchy of performance determinants: credit risk management emerges as the paramount factor, operational efficiency provides the most immediate improvement lever, while capital management involves nuanced trade-offs between safety and profitability. These insights inform strategic decision-making at both institutional and regulatory levels.

2. Literature Review and Theoretical Framework

2.1 Theoretical Foundations

Banking performance analysis draws from several theoretical paradigms. The Structure-Conduct-Performance (SCP) hypothesis suggests that market concentration influences bank behavior and profitability through pricing power mechanisms (Bain, 1951, p. 293) (Berger, 1995, p. 404)). Conversely, the Efficient Structure Hypothesis posits that superior operational efficiency drives performance regardless of market structure (Demsetz, 1973, p. 69) (Smirlock, 1985, p. 1)).

The Resource-Based View (RBV) emphasizes internal capabilities as sources of sustainable competitive advantage (Barney, 1991, p. 99) (Teece & et al, 1997, p. 509)). In banking, this translates to technological capabilities, human capital quality, risk management systems, and organizational routines that create value while remaining difficult to replicate.

Agency theory and corporate governance perspectives highlight how ownership structure and governance mechanisms affect risk-taking behavior, operational efficiency, and ultimately

financial performance (Myers & Majluf, 1984, p. 187). This is particularly relevant in Algeria's context with its mixed public-private banking structure.

2.2 Empirical Literature

International evidence consistently identifies several key performance drivers. Credit risk, typically measured through non-performing loan ratios, demonstrates robust negative associations with profitability across diverse banking systems (Louzis & et al, 2012, p. 1012). Operational efficiency, captured through cost-to-income ratios, represents a direct profitability determinant with significant cross-country evidence (Dietrich & Wanzenried, 2011, p. 307).

Net interest margins reflect banks' core intermediation function and pricing power, with positive performance implications documented extensively (Bikker & Hu, 2002, p. 143). Capital adequacy presents mixed empirical results: higher capital ratios enhance safety and reduce funding costs but may constrain leverage-based returns (Goddard & et al, 2004, p. 363).

Macroeconomic conditions significantly influence banking performance through multiple channels. Economic growth affects loan demand and credit quality, while inflation impacts real returns and operational costs (Flamini & et al, 2009, p. 1) (Espinoza & al, 2010, p. 1). For resource-dependent economies, commodity price fluctuations create additional transmission mechanisms (Pasiouras. & Kosmidou, 2007, p. 222).

2.3 Research Gaps and Contributions

Despite extensive international literature, several gaps persist in banking performance analysis for North African and oil-dependent economies. First, methodological limitations in addressing endogeneity and dynamics plague many existing studies. Second, comprehensive diagnostic validation remains uncommon, raising questions about inference reliability. Third, detailed ownership and crisis-period analyses are scarce for this regional context.

This study addresses these limitations through rigorous dynamic panel methodology, extensive diagnostic testing, and comprehensive institutional analysis tailored to Algeria's unique banking environment.

3. The Algerian Banking Sector Context

3.1 Structural Characteristics

Algeria's banking system comprises approximately 20 commercial banks controlling over 95% of sector assets. The system features a dual ownership structure: 10 public banks (including development institutions) and 8-10 private banks (both domestic and foreign-owned). Public banks historically dominated through extensive branch networks and government relationship advantages, while private institutions have gained market share through efficiency and service quality improvements.

3.2 Regulatory Environment

The Bank of Algeria serves as the central bank and prudential supervisor, implementing Basel II/III frameworks adapted to local conditions (Bank of Algeria, 2023, p. 15). Key regulatory requirements include minimum capital ratios (8% Tier 1, 10% total), provisioning standards aligned with international practices, and liquidity coverage requirements. Recent regulatory emphasis has focused on credit risk management, operational risk frameworks, and macroprudential measures.

3.3 Economic Context

Algeria's economy exhibits strong oil dependence, with hydrocarbon revenues comprising 60% of budget resources and 95% of export earnings (National Office of Statistics Algeria, 2024, p. 45). This creates significant macroeconomic volatility affecting banking sector performance through multiple channels: government deposit fluctuations, credit demand cycles, foreign exchange pressures, and inflation transmission effects.

4. Data and Methodology

4.1 Sample and Data Sources

Our analysis employs a balanced panel of 18 Algerian commercial banks over the period 2015-2024, yielding 180 bank-year observations representing approximately 95% of sector assets. The sample includes 10 public banks and 8 private institutions, providing comprehensive coverage of both ownership categories.

Data sources include:

- **Bank-level data:** Annual financial statements and regulatory reports
- **Supervisory data:** Bank of Algeria statistical bulletins and prudential reports
- **Macroeconomic data:** National Office of Statistics, Ministry of Finance, IMF databases
- **Commodity prices:** OPEC statistical bulletin, World Bank commodity data

4.2 Variable Definitions

4.2.1 Dependent Variables

- ROA: Return on Assets = Net Income / Average Total Assets
- ROE: Return on Equity = Net Income / Average Shareholders' Equity

4.2.2 Bank-Specific Variables

- CAR: Capital Adequacy Ratio = Regulatory Capital / Risk-Weighted Assets
- NPL: Non-Performing Loans Ratio = NPL / Gross Loans
- CIR: Cost-to-Income Ratio = Operating Expenses / Operating Income
- NIM: Net Interest Margin = Net Interest Income / Average Earning Assets
- SIZE: Bank Size = $\ln(\text{Total Assets})$
- LDR: Loan-to-Deposit Ratio = Total Loans / Total Deposits
- DIV: Income Diversification = Non-Interest Income / Total Income

4.3 Econometric Methodology

4.3.1 Model Specification

We employ a dynamic panel data model to capture performance persistence and control for unobserved heterogeneity:

$$\text{Performance}_{it} = \alpha + \lambda \text{Performance}_{it-1} + \beta' X_{it} + \gamma' Z_t + \mu_i + \varepsilon_{it}$$

Where Performance_{it} represents ROA or ROE for bank i in period t , $\text{Performance}_{it-1}$ captures performance persistence, X_{it} represents bank-specific variables, Z_t represents macroeconomic variables, μ_i captures unobserved bank-specific effects, and ε_{it} is the error term.

4.3.2 System-GMM Estimation

The presence of the lagged dependent variable and potential endogeneity of explanatory variables necessitates instrumental variable approaches. We employ the two-step system-GMM (Blundell & Bond, 1998, p. 115) which combines difference and level equations to improve efficiency and address weak instrument problems.

5. Empirical Results

5.1 Descriptive Statistics

Table 1: Descriptive Statistics (2015-2024)

Variable	Obs	Mean	Std.Dev	Min	Max	Median	Skewness	Kurtosis
ROA (%)	180	0.124	1.104	-3.716	3.557	0.097	-0.384	4.127
ROE (%)	180	7.830	6.405	-12.25	25.67	7.935	0.186	3.241
CAR (%)	180	17.05	3.409	11.00	26.00	17.00	0.421	2.876
NPL (%)	180	11.34	4.735	2.000	25.37	11.44	0.523	3.089
CIR (%)	180	53.44	13.47	28.00	82.00	53.20	0.157	2.643
NIM (%)	180	3.345	0.884	1.200	6.010	3.305	0.298	2.741
SIZE (ln)	180	12.76	0.891	10.85	15.23	12.68	0.445	2.934
GDPG (%)	180	1.761	2.620	-5.84	4.200	2.810	-1.234	4.567
OIL (\$/bbl)	180	66.16	17.55	39.10	103.9	67.95	0.089	2.234

Source: Authors' compilation.

5.2 Main Estimation Results

5.2.1 ROA Model Results

Table 2: System-GMM Results - ROA Model

Variable	Coefficient	Std. Error	z-statistic	p-value	95% Conf. Interval
L.ROA	0.234***	0.089	2.63	0.009	[0.059, 0.409]
CAR	0.084**	0.031	2.71	0.007	[0.023, 0.145]
NPL	-0.162***	0.047	-3.45	0.001	[-0.254, -0.070]
CIR	-0.073**	0.034	-2.15	0.032	[-0.140, -0.006]
NIM	0.341***	0.089	3.83	0.000	[0.167, 0.515]
GDPG	0.156**	0.067	2.33	0.020	[0.025, 0.287]
OIL	0.093**	0.035	2.66	0.008	[0.024, 0.162]
PRIVATE	0.127**	0.056	2.27	0.023	[0.017, 0.237]
COVID	-0.234**	0.098	-2.39	0.017	[-0.426, -0.042]

Model Diagnostics: Observations: 162; Banks: 18; Instruments: 42; Wald $\chi^2(14)$: 186.45 ($p = 0.000$)

5.2.2 ROE Model Results

Table 3: System-GMM Results - ROE Model

Variable	Coefficient	Std. Error	z-statistic	p-value	95% Conf. Interval
L.ROE	0.198**	0.078	2.54	0.011	[0.045, 0.351]
CAR	-0.234**	0.098	-2.39	0.017	[-0.426, -0.042]
NPL	-0.289**	0.123	-2.35	0.019	[-0.530, -0.048]
CIR	-0.198**	0.087	-2.28	0.023	[-0.369, -0.027]
NIM	1.987***	0.345	5.76	0.000	[1.311, 2.663]
GDPG	0.892***	0.234	3.81	0.000	[0.433, 1.351]
OIL	0.267**	0.134	1.99	0.047	[0.004, 0.530]
PRIVATE	0.789***	0.289	2.73	0.006	[0.223, 1.355]
COVID	-1.456**	0.567	-2.57	0.010	[-2.567, -0.345]

Model Diagnostics: Observations: 162; Banks: 18; Instruments: 42; Wald $\chi^2(14)$: 164.23 ($p = 0.000$)

5.3 Diagnostic Test Results

Table 4: Diagnostic Test Results

Test	ROA Model	ROE Model	Interpretation
AR(1) p-value	0.019	0.029	Expected (due to differencing)
AR(2) p-value	0.384	0.349	No second-order serial correlation
Hansen J p-value	0.127	0.431	Instruments jointly valid

Source: Authors' compilation.

5.4 Economic Interpretation of Results

- **Credit Risk (NPL):** Emerges as the most economically significant factor. A one percentage point increase in NPL ratio reduces ROA by 16.2 basis points and ROE by 28.9 basis points. This magnitude reflects both direct provisioning costs and broader portfolio quality implications.
- **Net Interest Margin (NIM):** Shows the strongest positive impact, particularly on ROE (198.7 basis points per percentage point increase). This highlights the critical importance of effective interest rate risk management and pricing strategies.
- **Capital Adequacy (CAR):** Demonstrates contrasting effects across performance measures. Higher capital improves ROA (+8.4 basis points) through enhanced safety and lower funding costs, but reduces ROE (-23.4 basis points) due to leverage constraints.
- **Private Bank Premium:** Private banks demonstrate superior performance across both measures, with ROA advantages of 12.7 basis points and ROE advantages of 78.9 basis points. This substantial premium suggests efficiency and governance advantages in private institutions.

5.5 Robustness Checks

Table 5: Robustness Check - Alternative Estimators

Variable	System-GMM	Diff-GMM	Fixed Effects	Random Effects	Pooled OLS
ROA Model					
NPL	-0.162***	-0.145**	-0.134***	-0.128***	-0.145***
CIR	-0.073**	-0.065**	-0.059**	-0.062**	-0.068***
NIM	0.341***	0.298***	0.267***	0.289***	0.312***

Source: Authors' compilation.

5.6 Ownership-Specific Analysis

Table 6: Ownership-Specific Effects

Variable	Public Banks	Private Banks	Difference Test
ROA Model			
NPL	-0.145**	-0.198***	p = 0.089
CIR	-0.056*	-0.098***	p = 0.034
NIM	0.298***	0.423***	p = 0.067

Source: Authors' compilation.

5.7 Temporal Analysis

Table 7: Temporal Evolution of Key Relationships

Variable	Pre-COVID	COVID	Post-COVID
NPL	-0.134***	-0.198***	-0.167***
CIR	-0.065**	-0.089**	-0.078**
NIM	0.312***	0.398***	0.356***
GDPG	0.123**	0.198**	0.145**
OIL	0.078**	0.134***	0.098**

Source: Authors' compilation.

6. Discussion and Policy Implications

6.1 Strategic Implications for Bank Management

6.1.1 Credit Risk Management as Core Priority

Our findings establish credit risk management as the paramount performance driver, with NPL impacts exceeding all other factors. This necessitates comprehensive risk management transformation through advanced credit scoring models incorporating macroeconomic stress scenarios, particularly oil price and GDP growth projections (Roodman, 2009, p. 86).

6.1.2 Operational Efficiency as Immediate Value Creator

The substantial efficiency dispersion (CIR range: 28-82%) indicates significant improvement potential for underperforming institutions. Digital transformation, core banking system modernization, and analytics-driven decision making can substantially reduce operational costs while improving service quality.

6.2 Regulatory and Supervisory Implications

The significant macroeconomic sensitivities documented support enhanced macroprudential tools, including countercyclical capital buffers linked to oil price cycles and GDP growth patterns, with automatic triggers based on predefined thresholds (Central Bank of Algeria, 2023, p. 28).

6.3 Public Bank Reform Framework

The substantial private-public performance gap necessitates comprehensive public bank reform through governance enhancement, strengthening of board independence, audit committee effectiveness, and risk committee functionality in public institutions.

7. Limitations and Future Research Directions

7.1 Study Limitations

While our dataset covers 95% of sector assets, inclusion of smaller institutions and non-bank financial institutions could provide additional insights into competitive dynamics and systemic risks. Despite rigorous diagnostic testing, GMM estimators remain subject to weak instrument concerns in small samples (Windmeijer, 2005, p. 25).

7.2 Future Research Opportunities

Future research opportunities include granular risk analysis, efficiency frontier analysis using data envelopment analysis, network analysis of interbank relationships, and comparative analysis with other oil-dependent economies or North African banking systems.

8. CONCLUSION

This comprehensive analysis of Algerian banking performance determinants provides robust

empirical evidence supporting several key conclusions with significant theoretical and practical implications. Our system-GMM analysis of 18 banks over 2015-2024 establishes a clear hierarchy of performance determinants:

- **Credit Risk Dominance:** NPL ratios emerge as the strongest performance detractor, emphasizing credit risk management as the fundamental banking competency.
- **Margin Management Criticality:** Net interest margins demonstrate the strongest positive performance impact, particularly on ROE.
- **Efficiency Imperative:** Substantial cost efficiency dispersion indicates large improvement potential.
- **Capital Trade-offs:** Capital adequacy shows contrasting effects on ROA versus ROE, confirming theoretical predictions.
- **Ownership Premium:** Private banks consistently outperform public institutions across all performance metrics.
- **Macroeconomic Vulnerability:** Strong sensitivity to GDP growth and oil prices confirms Algeria's economic dependence.

The study provides actionable insights for multiple stakeholders: bank management receives clear prioritization guidance, supervisory authorities obtain evidence supporting risk-based supervision frameworks, and policy makers gain guidance on financial system development priorities (World Bank, 2024, p. 67).

As Algeria continues its economic development and financial sector modernization, the insights from this analysis provide an empirically-grounded foundation for strategic decision-making at both institutional and policy levels.

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