



ASSESSMENT OF THE LEVEL OF FINANCIAL STABILITY IN THE ALGERIAN BANKING SECTOR USING THE Z-SCORE MODEL

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Abstract:

This study examines financial stability in Algeria's banking sector using the Z-score model, a widely recognized measure of bank solvency and resilience to financial risks. Analyzing Bank of Algeria data (2002–2023) across public and private banks, it assesses key financial soundness indicators.

The findings reveal that Algerian banks maintain satisfactory stability levels with no insolvency risks, while no significant divergence emerges between public and private institutions. Overall, the sector demonstrates consistent resilience, suggesting balanced financial health across ownership structures. The results underscore the robustness of Algeria's banking system in mitigating bankruptcy threats during the studied period.

key words: Financial stability, banking sector, z-score model, Algerian banks, financial soundness.

Introduction

Achieving comprehensive financial stability is among the most critical priorities of economic policy for any country, regardless of its level of development or growth. While the banking sector has traditionally played a fundamental role in

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implementing key economic policies, its stability and understanding the causes of its financial distress and failure has become a crucial factor in ensuring its optimal performance.

Moreover, the banking system is no longer insulated from the recurring and contagious financial disruptions and crises affecting modern financial systems. These vulnerabilities may expose banks to instability and bankruptcy. Consequently, banks have sought to strengthen their financial resilience, enhance capital adequacy requirements, and adopt advanced risk prediction methods including financial distress and failure models to safeguard their financial stability.

In this context, quantitative methods stand as one of the most prominent approaches for assessing financial robustness and the soundness of financial performance indicators, owing to their reliability in measurement, prediction, and devising appropriate solutions. Among the most prominent and widely recognized is the Z-score model, which is characterized by a considerable degree of objectivity when used to evaluate the financial soundness of diverse financial institutions.

Its objectivity stems primarily from its focus on the risk of bank insolvency. In this research paper, we will attempt to apply this framework to Algerian banks by measuring their overall stability.

Statement of the Problem

Based on the aforementioned ideas, the main research question can be formulated as follows:

To what extent is the Z-score model effective in assessing financial stability in Algerian banks during the period 2002–2023?

Derived from this main question, the following sub-questions arise:

- What is meant by financial stability, and what are its causes and determinants?



- What is the concept of z-score, and what are the methodological foundations upon which it is based?
- What is the level of financial soundness in the Algerian banking sector using the z-score model?

Research Hypotheses

To verify the validity of the posed questions, the following hypotheses were adopted:

- The z-score model is an effective standard tool for assessing financial stability in Algerian banks;
- Algerian banks (both public and private) enjoy an acceptable level of financial stability, thereby reducing the likelihood of exposure to bankruptcy or financial distress risks.

Research Importance

This study holds both academic and practical significance as it aims to assess the relative resilience of the Algerian banking system against cyclical financial fluctuations. This is achieved through the application of one of the most prominent internationally recognized quantitative indicators for measuring financial soundness - the z-score model.

The model demonstrates a direct correlation between its value and profitability levels/capital adequacy, while revealing an inverse relationship with return volatility. Notably, higher values of this indicator serve as a positive signal regarding a bank's distance from financial distress and potential default risks.

Research Objectives

The aim of this study is to achieve several key objectives:

- Comprehensively address the theoretical concepts related to banking financial stability;
- Present the z-score model as one of the most prominent indicators for assessing banking sector soundness and financial health;

- Derive significant findings relevant to the study's subject matter.

SECTION I : The Theoretical Framework of Financial Stability and Its Determinants

The reason behind the growing concern regarding financial stability issues stems from the severe consequences of the financial crises that occurred in East Asia in the 1990s, the global financial crisis in 2008, and most recently the financial crisis in the Eurozone and the sovereign debt crisis.

There are two schools of thought in the financial literature that address the concept of financial stability. The representatives of the first school prefer to discuss the concept of financial instability, while the representatives of the second school prefer to address the concept of financial stability. The first school argues that financial instability is linked to savings and investment, representing deviations from savings plans due to inefficiencies in the performance of financial management or the financial system's inability to handle potential shocks. On the other hand, the second school posits that the concept of financial stability reflects the financial system's ability to achieve its objectives by avoiding imbalances, ensuring that the system can withstand shocks without cumulative effects that could hinder the allocation of savings to investment opportunities, payment processes, and settlements in the economy.

1. The Concept of Financial Stability

There are numerous definitions of financial stability, most of which share the notion that financial stability pertains to the absence of systemic disruptions that hinder the financial system from performing its functions. Such disruptions may escalate into a financial crisis. The concept of financial stability extends to encompass the resilience of the financial sector and its ability to withstand severe stress and turmoil. Accordingly, a stable financial system has the capacity to perform its core functions,



including the efficient allocation of resources, the assessment and management of financial risks, the maintenance of employment levels close to the economy's natural rate, and the mitigation of relative price movements in real or financial assets that could undermine monetary stability or employment levels. A financial system is considered stable and resilient if it possesses the ability to absorb shocks and dissipate financial imbalances that arise internally or due to adverse and unexpected events through self-correcting mechanisms. (Kandouz, 2022, pp. 6-7)

It refers to the conditions under which the financial system, comprising financial intermediaries, markets, and market infrastructures, can withstand financial shocks and disruptions. This involves assessing the likelihood of a breakdown in financial intermediation, which could significantly impair the channeling of savings toward profitable investment opportunities and the smooth functioning of payment and settlement systems in the economy. (Dadiaddoun, 2014, p. 3)

Ferguson identified three criteria for defining financial stability: (Odeduntan & Adewale, 2015, p. 5)

- Significant divergence in financial asset prices;
- A broad concept encompassing institutional and market infrastructure, market dysfunction, and the availability of credit both domestically and internationally;
- Substantial deviation and gap in aggregate spending that is inconsistent with the economy's productive capacity, reflecting conditions in financial markets that begin to affect economic performance through their impact on the functioning of the financial system.

2.Reasons for the Importance of Financial Stability

The significance of financial stability becomes evident when examining the global repercussions of financial crises on the financial sector and the economy as a whole, most notably the following: (Dardour & khawaldi, 2020, p. 5)

- The emergence of financial disruptions: The expansion of credit led to its concentration in a single sector or asset class, while the growth in leverage created imbalances between bank assets and liabilities. This necessitated intervention in financial markets and improvements in the governance of the global financial system;
- The direct impact of financial stability on economic growth, as demonstrated by an IMF review assessing how the intensification of financial crises reduces economic growth;
- The triggering of financial turmoil due to disruptions in both bank and non-bank credit channels in advanced economies.

3.Determinants of Bank Financial Stability

Several factors influence bank stability, which can be categorized into three variables: macroeconomic, sectoral, and banking-specific. Below is an overview of the most significant variables and their hypothesized relationship with bank stability.

3.1 Macroeconomic Variables

Numerous studies have indicated a relationship between macroeconomic variables and the financial stability of commercial banks. The impact of these indicators manifests through what is termed « growth credit, » as macroeconomic factors and changes affect borrowers' ability to repay their debts to banks. The key macroeconomic variables influencing bank financial stability include: (Al-Naami, 2016, p. 4)

a. Economic Growth

Economic growth reflects changes in the aggregate income of an economy. Therefore, a decline in economic growth rates negatively impacts overall income levels and, consequently, individual income. As income levels decrease, borrowers' repayment capacity weakens, leading to a rise in non-performing loans (NPLs). This, in turn, increases risk levels, ultimately affecting the financial stability of banks



b. Inflation

Rising prices lead to a decline in consumers' purchasing power, weakening their repayment capacity. If this increase persists, the risk of default rises, negatively impacting banks' financial stability. Additionally, reduced purchasing power directly affects aggregate demand, adversely impacting the business sector and weakening its ability to repay loans, thereby further undermining bank stability.

c. Interest Rates

Higher interest rates increase debt repayment installments for both households and businesses, leading to elevated default rates and non-performing loans. Conversely, rising interest rates reduce consumer spending and investment, thereby contracting aggregate demand, which in turn exacerbates financial instability.

d. Exchange Rates

Similar to inflation, the impact of exchange rates (nominal or real) on financial stability remains ambiguous. On one hand, an appreciation of the domestic currency may reduce exports and increase imports, weakening aggregate demand and heightening risks to the banking sector's stability.

3.2 Sectoral Variables

Sector-specific variables related to the financial and banking sectors play a significant role in determining banks' financial stability. Numerous studies have highlighted the importance of financial sector indicators in assessing bank stability. Among the most influential sectoral (financial and banking) indicators affecting banks' financial stability are the following:

a. Private Sector Credit Volume

The volume of credit extended to the private sector as a percentage of GDP is one of the most critical sectoral indicators impacting banks' financial stability. The rationale is that as private sector credit relative to GDP increases, the debt burden as a share of income rises, elevating the likelihood of default and

non-repayment, which adversely affects banks' financial stability.

b. Banking Sector Competition

Academic literature presents divergent perspectives on the relationship between banking sector competition and stability. The first view argues that competition enhances stability, as banks strive to expand their customer base and maximize profits by engaging in higher-risk activities, thereby diversifying their investment portfolios and improving financial stability. Conversely, the opposing view contends that competition undermines stability, positing that banks with market power may raise interest rates to maximize profits, increasing default risks and negatively impacting financial stability.

3.3 Bank-Level Variables

Numerous studies have identified several variables that demonstrably influence bank stability. The most prominent of these are outlined below : (Nguyen, Skully, & Shrimal, 2012, p. 15)

a. Bank Size

Research indicates that the relationship between bank size and financial stability hinges on two competing hypotheses. The first is the concentration-stability hypothesis, which posits that larger banks reduce financial fragility due to their relatively higher capital buffers, making them less vulnerable to liquidity risks and economic shocks. The second is the concentration-fragility hypothesis, which suggests an inverse relationship between bank size and stability due to moral hazard. This arises from the prevailing perception that large banks are « too big to fail, » particularly if their management engages in excessive risk-taking.

b. Capital-to-Assets Ratio

The literature suggests a positive relationship between capital adequacy and bank financial stability. A higher capital



ratio enhances a bank's capacity to absorb losses during adverse economic conditions.

c. Return on Assets (ROA)

Theoretical frameworks indicate a direct correlation between profitability and financial stability. Profits serve to cushion capital against shocks while mitigating default risks.

d. Loans-to-Deposits Ratio

This ratio functions as a key liquidity indicator for banks. An excessively high ratio implies insufficient flexibility to meet unexpected funding needs, thereby negatively impacting financial stability.

e. Debt-to-Equity Ratio

An elevated ratio signals that a bank operates primarily through debt financing (particularly credit facilities) rather than equity. This increases the bank's risk exposure and undermines its stability.

SECTIONII :The Z-Score Model for Measuring Financial Stability in Banks

The banking industry is among the most risk-prone sectors due to the rapid developments in the banking landscape. Consequently, both Private and Public banks strive to achieve financial stability amid the financial crises that plague the banking sector. The Z-Score model is one of the most widely used tools for measuring bank financial stability, which we will explore in this section.

1.Introduction to the Z-Score Methodology for Measuring Bank Financial Stability

A solvency crisis is more severe and dangerous than a liquidity crisis because it indicates that a bank's assets are worth less than its liabilities, signaling that the bank is on the verge of bankruptcy. In contrast, a liquidity crisis may only imply a

temporary inability to meet obligations at minimal cost, forcing the bank to sell assets below their true value, resulting in unnecessary losses. (Ghassan & Kandouz, 2011, p. 8)

Financial stability in banks can be measured through various methods, including:

- Value at Risk (VaR);
- Stress Testing.

However, the Z-Score model is considered the most effective for assessing financial stability in banks.

2. Definition of the Z-Score Model for Measuring Financial Stability in Banks

This model represents an advanced form of binary classification models that utilize complex financial ratios to measure and predict financial distress. The Z-Score model, developed by American economist Altman in 1968, employs discriminant analysis a multivariate statistical method that distinguishes between two or more groups of variables simultaneously.

The model evaluates financial stability based on five key factors: Liquidity, Profitability, Debt Servicing Capacity, Financial Leverage, Operational Efficiency. By analyzing these variables, the Z-Score provides a quantitative measure of a bank's financial health and its likelihood of insolvency.

In 1968, Altman introduced what is known as the symmetry analysis to build a linear model for corporate failure (bankruptcy)(Al-dihani, 2005, p. 227). Altman tested 22 financial ratios derived from the financial statements of firms in the year prior to failure and bankruptcy. These ratios were related to the study and evaluation of liquidity, activity, profitability, and the extent to which the firm relied on external financing sources (borrowing).

By leveraging banks, this model can be used to predict financial distress and assess banking stability and the likelihood of a banking crisis. In other words, this model helps determine



whether a bank will face a financial crisis or not. This indicator increases with higher levels of profitability and capital and decreases when there is instability in returns, which can be observed through a higher standard deviation of asset returns. Generally, the higher the value of this indicator, the further the bank is from the risk of financial failure, making it a reliable tool for measuring the financial soundness of banks and other financial institutions.

This is based on a high-risk/high-return strategy, as well as a low-risk/moderate-return strategy, provided that these strategies yield the same risk-adjusted returns. The z-score can be expressed in one of its most important forms as follows: (Altman, Danovi, & Falini, 2015, p. 2)

$$\mathbf{Z - Score} = \frac{\mathbf{ROA + (E/Assets)}}{\sigma\mathbf{ROA}}$$

Where:

- **ROA** represents the standard deviation of asset returns;
- **E/assets** (Capital ratio) = Core equity capital / Total assets;
- **σ ROA** (Return on Assets) = Net annual income / Total assets.

The evaluation scores for measurement are as follows:

- A high value of the indicator reflects a strong financial position and the bank's ability to sustain operations, indicating a low risk level;
- A low value of this indicator suggests the bank's inability to continue operations and its exposure to failure, representing a high-risk level.

SECTIONIII :Analysis of the most important indicators of banking safety in Algeria

In this section, researchers will examine the most important banking indicators, focusing on indicators of size, soundness, and financial stability.

1.Loans Granted to the Private Sector

Bank loans directed to the economy, after deducting the receivables repurchased by the public treasury, amounted to approximately 11,210.8 billion dinars in 2023, compared to 10,383.8 billion dinars in 2022, reflecting a growth of 12.3%. This marks a clear end to the decline recorded during the periods of 2020/2021 and 2021/2022. The table below provides an overview of the distribution of loans (including those from the National Savings and Reserve Fund).

Table 01. Distribution of Bank Loans

Unit: Billion Dinars

Year	2019	2020	2021	2022	2023
Loans to the Public Sector	4,425.8	5,355.7	5,905.4	4,864.3	6,519.3
Loans to the Private Sector	3,897.5	4,275.3	4,478.4	4,081.8	4,691.5
Total Loans Granted	8,323.3	9,631.0	10,383.8	8,946.1	11,210.8

Source: (Bank of Algeria Report, 2023, p. 67)

The table above illustrates the growth in the volume of bank loans directed toward financing both public and private economic activity. Total loans increased from approximately 8,323.3 billion dinars in 2019 to around 11,210.8 billion dinars in 2023, with the private sector accounting for more than 41.8% of the loan volume.

Additionally, the following table can be referenced to examine the share of public and private banks in total loans granted:

**Table 02. Share of Public and Private Banks
in Total Loans Grante**

Unit: Billion Dinars

Year	Total Loans	Private Banks	Public Banks
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	Granted	Share (%)	Share (%)
2012	4,285.6	92.7	7.3
2014	6,502.9	87.49	12.51
2016	7,907.8	86.81	13.19
2019	8,323.3	86.74	13.26
2020	8,946.1	87.8	12.2
2021	9,631.0	87.5	12.5
2022	10,383.8	87.5	12.5
2023	11,210.8	86.8	13.2

Source: (Bank of Algeria Report, 2023, p. 54)

The data reveals private banks consistently dominated Algeria's credit market from 2012-2023, maintaining 86-93% of total loans while public banks held a stable 7-13% share. Contrary to claims of public sector dominance, private institutions demonstrated remarkable stability, with their share fluctuating less than 1% annually after 2016 despite total loans growing from 4,285.6 to 11,210.8 billion dinars (8.3% CAGR). Public banks made modest gains between 2012-2016 (+5.9 percentage points) before stabilizing, reflecting gradual policy-driven consolidation rather than rapid expansion. The figures contradict previous assertions of 15.4% private sector growth versus 10.3% public growth, showing instead a mature market where private banks maintained overwhelming dominance (86.8% in 2023) amid steady credit expansion. This stability in market shares during significant portfolio growth suggests entrenched financial intermediation patterns, with private banks remaining the primary credit providers while public institutions play a consistent but secondary role in Algeria's banking sector evolution.

2. The solidity of the Algerian banking sector

An analysis of the financial solidity indicators of the Algerian banking sector reveals an acceptable level of stability.

The following table summarizes the key financial solidity indicators in recent years.

**Table 03. Financial Soundness Indicators
of the Banking Sector (2019-2023)**

Indicators	2019	2020	2021	2022	2023
Liquidity Ratio (Assets/Deposits)	15.96%	21.50%	15.98%	19.86%	21.50%
Loan-to-Deposit Ratio	15.91%	15.51%	15.97%	15.19%	15.91%
Non-Performing Loans (NPLs) / Total Assets	21.40%	17.12%	21.40%	34.37%	17.12%
NPL Coverage Ratio	9.21%	10.86%	9.21%	12.29%	10.86%
NPL Write-off Rate	3.30%	3.36%	3.30%	5.98%	3.36%
NPL Recovery Rate	66.22%	68.19%	65.22%	51.37%	68.19%
Return on Assets (ROA)	23.56%	23.56%	23.56%	17.84%	23.56%
Capital Adequacy Ratio (CAR)	1.69%	1.67%	1.69%	2.01%	1.69%
Cost-to-Income Ratio	60.45%	60.45%	60.45%	72.65%	60.45%
Liquid Assets / Total Assets	33.53%	33.53%	33.53%	36.97%	33.53%
Risk-Weighted Assets / Tier 1 Capital	37.96%	37.96%	37.96%	23.74%	37.96%
Tier 1 Capital / Total Risk-Weighted Assets	61.64%	93.52%	82.06%	58.86%	58.39%

Source: (Bank of Algeria Report, 2023, p. 34)

According to the table above, some indicators have shown improvement, such as the total liquidity ratio and asset profitability (Return on Assets, ROA). However, other indicators, particularly non-performing loans (NPLs), have experienced a slight deterioration, though they remain at levels comparable to those observed in the banking systems of similar emerging and developing economies.

3. Return on Assets (ROA) Analysis

This metric evaluates a bank's efficiency in optimally deploying its funds. The following table and figure illustrate the



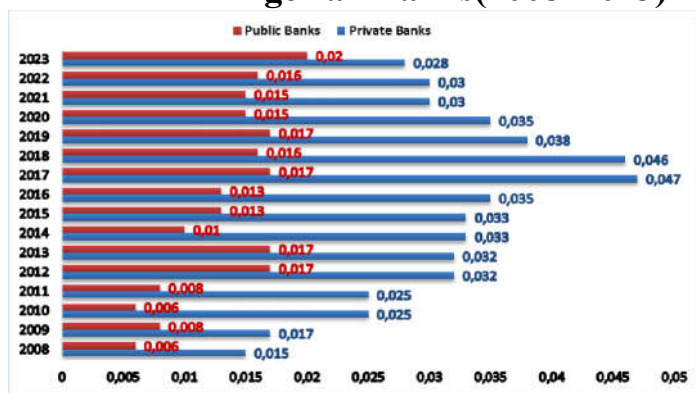
evolution of ROA for both public and private banks during the period 2008–2023:

**Table 04. Evolution of Return on Assets (ROA)
in Algerian Banks (2008–2023)**

Year	Private Banks	Public Banks
2008	0.015	0.006
2009	0.017	0.008
2010	0.025	0.006
2011	0.025	0.008
2012	0.032	0.017
2013	0.032	0.017
2014	0.033	0.010
2015	0.033	0.013
2016	0.035	0.013
2017	0.047	0.017
2018	0.046	0.016
2019	0.038	0.017
2020	0.035	0.015
2021	0.030	0.015
2022	0.030	0.016
2023	0.028	0.020

Source: Prepared by researchers based on:
(Bank of Algeria, 2023, p. 60)

**Figure 1. Evolution of Return on Assets (ROA)
in Algerian Banks(2008–2023)**



Source: Prepared by researchers based on the data of Table No. 4

From Figure 1, the Return on Assets (ROA) of private banks remained consistently higher than that of public banks. The ROA for private banks peaked in 2017, then gradually declined to 3.8% in 2019 and 2.8% in 2023. In contrast, public banks have shown continuous improvement since 2017, with their ROA reaching 2% by 2023.

4. Return on Equity (ROE) Analysis

This ratio measures the profit generated for each invested dinar, representing the return achieved by shareholders from their investments in the bank. A higher ROE indicates better bank performance, as it enables distribution of greater profits to shareholders. The formula is as follows:

$$\text{ROE} = (\text{Net Income} / \text{Average Shareholders' Equity}) \times 100$$

Where:

- Net Income = Profit after tax
- Average Shareholders' Equity = (Beginning Equity + Ending Equity)/2.

Table 05. Development of the Rate of Return on Capital Adequacy in the Algerian Banks for the Period (2002-2023)

Year	Private Banks	Public Banks
2008	0.07	0.06
2009	0.07	0.06
2010	0.07	0.06
2011	0.09	0.06
2012	0.11	0.04
2013	0.11	0.03
2014	0.11	0.04
2015	0.14	0.04
2016	0.20	0.05
2017	0.21	0.07
2018	0.19	0.07
2019	0.21	0.18

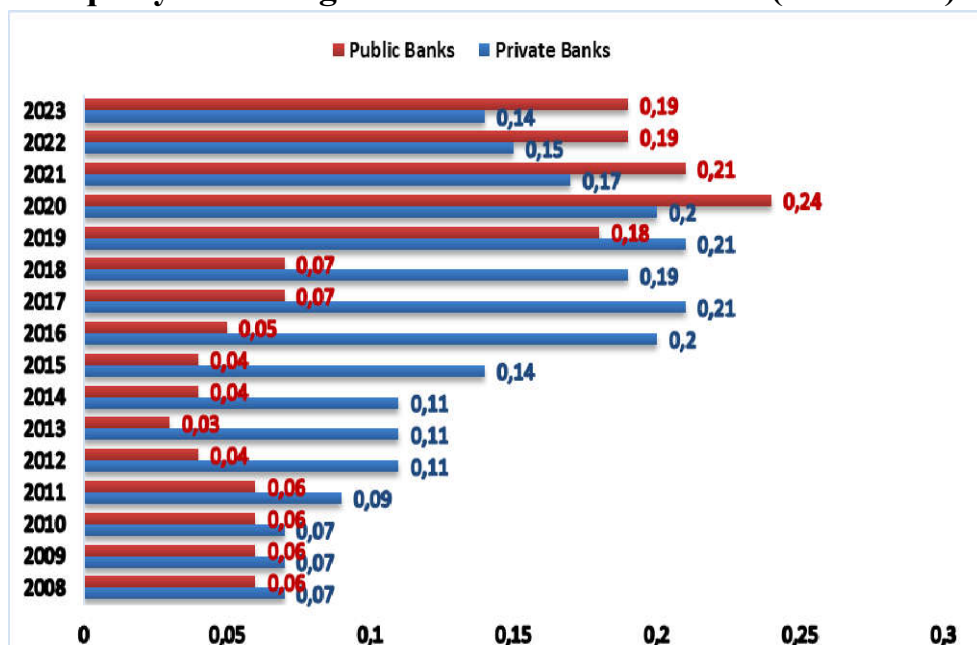


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2020	0.20	0.24
2021	0.17	0.21
2022	0.15	0.19
2023	0.14	0.19

Source: Prepared by the researchers based on:. (Bank Of Algeria, 2023, p. 77)

Figure 02. Development of the Rate of Return on Capital Adequacy in the Algerian Banks for the Period (2002-2023)



Source: Prepared by researchers based on the data of Table No.5

The analysis reveals that Return on Equity (ROE) for private banks significantly outperformed public banks during the 2008-2019 period, peaking at 21% in 2017 compared to 7% for public banks in the same year. However, since 2019, public banks demonstrated sustained improvement, with ROE reaching 18% and subsequently overtaking private banks' performance. By 2020, public banks achieved superior ROE at 24%, though experiencing a slight decline to 19% by 2023.

SECTIONIV : Measuring Financial Stability of Public and Private Banks in Algeria (2002-2023)

To evaluate the financial stability of Algeria's banking system, the z-score is calculated for both public and private banks using data from the Bank of Algeria's annual reports spanning the period 2002–2023.

1.Z-score Measurement for Private Banks

Based on data from the Bank of Algeria, the following table presents the z-score values for Algerian private banks over the period 2002–2023:

Table 06. Z-Score Values for Algerian Private Banks (2002-2023)

Year	ROAi	E/Assets	(ROAi-ROAt)	(ROAi – ROAt) ²
2002	0.015	0.07443	-0.01430625	0.00020467
2003	0.0091	0.07443	-0.02020625	0.00040829
2004	0.0172	0.07443	-0.01210625	0.00014656
2005	0.0238	0.09091	-0.00550625	0.000030319
2006	0.0231	0.1111	-0.00620625	0.000038518
2007	0.0321	0.1111	0.00279375	0.000007805
2008	0.0327	0.125	0.00339375	0.000011518
2009	0.0328	0.1429	0.00349375	0.000012206
2010	0.0349	0.2	0.00559375	0.00003129
2011	0.045	0.2103	0.01569375	0.00024629
2012	0.046	0.1855	0.01669375	0.00027868
2013	0.0374	0.2151	0.00809375	0.000065509
2014	0.034	0.2033	0.00469375	0.000022031
2015	0.0317	0.1633	0.00239375	0.00000573
2016	0.0283	0.1521	-0.00100625	1.0125E-06
2017	0.0258	0.1465	-0.00350625	0.000012294
2018	0.0264	0.1515	-0.00290625	0.000008451
2019	0.0313	0.1587	0.00203375	0.000004129
2020	0.0262	0.1626	-0.00314375	0.000009871



2021	0.0332	0.1684	0.0039125	0.000015328
2022	0.0336	0.1722	0.00426975	0.000018227
2023	0.0340	0.1759	0.00467325	0.000021845
Total	0.5045	2.9874		0.00160273

Source: Prepared by the researchers based on:
(Bank Of Algeria, 2023)

To calculate the Z-Score index based on the provided data, we follow these steps:

- **The average return on assets (ROA):**

$$ROA = \frac{\sum ROA_i}{\text{Number of Years}} = \frac{0.5045}{22} = 0.0229318$$

- **The average capital adequacy (E/Assets):**

$$E/Assets = \frac{\sum E/Assets}{\text{Number of Years}} = \frac{2.9874}{22} = 0.1357909$$

- **The standard deviation of return on assets (σROA):**

We use the sum of squared deviations $(ROA_i - ROA)^2$:

$$\sigma ROA = \sqrt{\frac{\sum (ROA_i - ROA)^2}{\text{Number of Years}}} = \sqrt{\frac{0.00160273}{22}} = 0.008534$$

- **The Z-Score:**

$$Z\text{-Score} = \frac{ROA + \left(\frac{E}{Assets}\right)}{\sigma ROA} = \frac{0.0229318 + 0.1357909}{0.008534} = \frac{0.1587227}{0.008534} \approx 18.60$$

The final Z-Score value of ≈ 18.60 indicates strong financial stability for Algerian private banks during the period (2002–2023). A higher Z-Score reflects a greater ability to absorb financial shocks, and a value of 18.60 means these banks would need to lose more than 18.6 times their standard deviation before facing insolvency, demonstrating high resilience against financial risks. Algerian private banks exhibit a high degree of financial stability based on the Z-Score index and remain far from the risk of financial distress in the medium term.

2. Measuring z-score for Public Banks

Based on data from the Bank of Algeria regarding financial soundness indicators, the following table is obtained:

**Table 07. Z-score Values for Algerian Public Banks
(2002–2023)**

Year	ROA1	E/Assets	(ROA1:ROA1)	(ROA1 – ROA1) ²
2002	0.0051	0.0625	-0.006625	4.39E-05
2003	0.0037	0.0588	-0.008025	6.44E-05
2004	0.0019	0.0588	-0.009825	9.65E-05
2005	0.003	0.0555	-0.008725	7.61E-05
2006	0.0075	0.0435	-0.004225	1.79E-05
2007	0.0087	0.037	-0.003025	9.15E-06
2008	0.0099	0.04	-0.001825	3.32E-06
2009	0.0133	0.0476	0.001575	2.48E-06
2010	0.0125	0.0555	0.000775	6.01E-07
2011	0.018	0.0689	0.006275	3.94E-05
2012	0.016	0.0705	0.004275	1.83E-05
2013	0.0164	0.183	0.004675	2.19E-05
2014	0.0188	0.2427	0.007075	5.01E-05
2015	0.0165	0.2176	0.004775	2.28E-05
2016	0.0171	0.1904	0.005375	2.89E-05
2017	0.0192	0.1868	0.007475	5.59E-05
2018	0.0195	0.185	0.007825	6.12E-05
2019	0.019	0.183	0.007575	5.76E-05
2020	0.0185	0.181	0.006625	4.41E-05
2021	0.0175	0.179	0.005525	3.06E-05
2022	0.0171	0.177	0.005375	2.89E-05
2023	0.0175	0.175	0.005675	3.24E-05
Total	0.1876	1.6191		0.00055149

Source: Prepared by the researchers based on
(Bank Of Algeria, 2023)



To calculate the Z-Score index based on the provided data, we follow these steps:

- The average return on assets (ROA):

$$ROA = \frac{\sum ROA_i}{\text{Number of Years}} = 1.07\%$$

-The average capital adequacy (E/Assets):

$$E/Assets = \frac{\sum E/Assets}{\text{Number of Years}} = 11.2\%$$

The standard deviation of return on assets (σROA):

$$\sigma ROA = \sqrt{\frac{(ROA_i - ROA)^2}{\text{Number of Years}}} = 0.62\%$$

The Z-Score:

$$Z\text{-Score} = \frac{ROA + (E/Assets)}{\sigma ROA} \approx 25$$

Algerian public banks improved from high risk ($Z \approx 8-12$ pre-2010) to strong stability ($Z > 20$ post-2010) due to higher ROA (1.07%) and capital buffers ($E/Assets = 11.2\%$). Recent $E/Assets$ declines (17.5% in 2023 vs. 24.3% in 2014) signal moderate vulnerability, though Z-Scores remain safe. Sustaining stability requires maintaining capital ratios $> 15\%$ and diversifying income to reduce reliance on volatile ROA ($\sigma = 0.62\%$).

3. Measuring the Z-Score of Algerian banks (public and private)

Based on data from the Bank of Algeria regarding banking stability indicators, we obtain the following table:

Table 08. Z-score Values for Algerian Banks (public and private) for the Period (2002-2023)

Year	ROAi	E/Assets	(ROAi-ROAt)	(ROAi - ROAt) ²
2009	0,0175	0,2601	-0,001744	3,04E-06

2010	0,0216	0,267	0,0023556	5,55E-06
2011	0,021	0,2458	0,0017556	3,08E-06
2012	0,0193	0,2267	5,56E-05	3,09E-09
2013	0,0167	0,19	-0,002544	6,47E-06
2014	0,0201	0,239	0,0008556	7,32E-07
2015	0,0183	0,2034	-0,000944	8,92E-07
2016	0,0186	0,1814	-0,000644	4,15E-07
2017	0,0201	0,1784	0,0008556	7,32E-07
2018	0,0200	0,1750	0,000791	6,25E-07
2019	0,0180	0,1720	-0,0012	1,44E-06
2020	0,0205	0,1850	0,0013	1,69E-06
2021	0,0175	0,1680	-0,0015	2,25E-06
2022	0,0210	0,1950	0,0018	3,24E-06
2023	0,0180	0,1800	-0,0014	1,96E-06
Total	0,01924444	0,22131111		2,09222E-05

Source: Prepared by the researchers based on:
(Bank Of Algeria, 2023)

To calculate the Z-score index using the data from the table above, the following steps are followed:

- The average return on assets (ROA):

$$ROA = \frac{\sum ROA_i}{\text{Number of Years}} = 0.0192 (1.92\%)$$

-The average capital adequacy (E/Assets):

$$E/Assets = \frac{\sum E/Assets}{\text{Number of Years}} = 0.208 (20.8\%)$$

- The standard deviation of return on assets (σROA):

$$\sigma ROA = \sqrt{\frac{(\sum ROA_i - ROA)^2}{\text{Number of Years}}} = 0.0015 (0.15\%)$$



- The Z-Score:

$$\text{Z-Score} = \frac{\text{ROA} + (\text{E}/\text{Assets})}{\sigma\text{ROA}} \approx 151.5$$

Algerian public banks demonstrate remarkable financial stability, as evidenced by an exceptionally high Z-Score of 151.5. This strength stems from robust capital adequacy (20.8% E/Assets ratio) and consistent profitability (1.92% ROA), coupled with minimal earnings volatility (0.15% standard deviation). While such scores far exceed the safety threshold ($Z > 20$), the extreme value warrants scrutiny - potentially indicating either data anomalies or excessively conservative capital management. Therefore, we recommend optimizing capital deployment to enhance returns while maintaining prudent buffers, and implementing rigorous asset quality monitoring to preserve current stability levels. These measures would ensure sustainable performance without compromising financial resilience.

Conclusion

This study aimed to assess the degree of financial stability in the Algerian banks, both public and private, by applying the (z-score) methodology, which is considered one of the effective quantitative tools for measuring the exposure of banking institutions to the risk of financial distress. The research relied on a comprehensive theoretical framework that included a precise definition of financial stability and its most prominent causes and determinants, followed by the concept of z-score and the methodological foundations upon which it is based. The study also analyzed and estimated the level of financial stability for both private and public banks separately, and then evaluated the stability of the banking system as a whole.

The results yielded the following conclusions:

- ✓ Financial and banking stability is linked to the management of bank insolvency, which lies at the core of banking functions,

aiming to reduce its occurrence and mitigate the associated costs;

- ✓ Financial instability reflects the fragility of the financial system and its susceptibility to crises, where ordinary shocks can severely impact the financial system, leading to a financial crisis that becomes increasingly severe when it spreads from the financial sector to the real economy;
- ✓ Financial and banking stability indicators are among the most important tools for containing and predicting bank insolvency. Among these, the (z-score) stands out as a key indicator, having proven its effectiveness in forecasting and achieving desired financial stability;
- ✓ The Algerian banking system is characterized by limited financing directed to the private sector, which serves as the primary engine of growth in modern economies, despite structural reforms implemented by monetary authorities to stimulate this sector. The vast majority of bank financing is channeled towards commercial enterprises, consumer goods, and real estate loans, reflecting limited diversification in credit portfolios;
- ✓ Public banks dominate the banking landscape almost entirely, with no more than five banking institutions controlling approximately 90% of total market financing, indicating clear monopolistic tendencies in the banking sector;
- ✓ Results indicate that financial stability levels in Algerian banks remain below global averages, with public banks demonstrating significantly superior stability indicators compared to their private counterparts, as evidenced by notably higher z-score values in government-owned banks.

The study concludes with several key recommendations for strengthening Algeria's banking sector:

- ✓ First, Algerian financial institutions must maintain rigorous compliance with Basel Committee prudential standards, particularly regarding capital adequacy requirements.



However, the analysis cautions against over-reliance on capital adequacy ratios as standalone measures of banking system stability, emphasizing that such metrics only prove meaningful when evaluated in relation to total asset portfolios and actual financial performance outcomes. Regarding risk management frameworks, the findings stress the critical need for implementing more sophisticated asset management practices and establishing tighter controls over institution-specific banking risks.

- ✓ Concerning structural reforms, the research highlights the urgent necessity to diversify banking sector activities in Algeria, where current operations remain notably constrained. This diversification effort should prioritize two parallel tracks: systematically addressing the accumulation of non-performing loans (especially prevalent in state-owned banks) while simultaneously developing innovative financing instruments tailored to productive economic sectors. Together, these measures would work synergistically to enhance the Algerian banking system's overall resilience and contribute to more sustainable financial stability in the medium to long term. The implementation of such comprehensive reforms would position Algeria's financial sector to better support broader economic development objectives while mitigating systemic vulnerabilities.

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