

Risk Management and Bank Performance in Morocco: An Empirical Analysis of Prudential and Operational Dimensions

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Abstract:

The pursuit of sustainable performance increasingly compels credit institutions to balance profitability objectives with escalating risk management demands. In this regard, risk management has evolved beyond a mere compliance exercise to become a strategic function: serving as a guiding force during planning, a regulatory mechanism throughout operations, and a means of ensuring adherence to prudential standards.

This study contributes to this evolving paradigm by examining the joint impact of prudential and operational risk management approaches on the financial performance of Moroccan banks. Based on a panel of six major commercial banks over the period 2010–2024, and employing an ARDL-PMG model, the analysis provides empirical evidence of a significant relationship between specific risk management levers, namely: operational risk, the cost of credit risk, and the loan-to-deposit (LTD) ratio, and bank profitability.

Conversely, conventional prudential indicators, such as the Tier 1 capital ratio and market risk-weighted assets, do not exert a direct influence on performance. These findings underscore the importance of an integrated approach, wherein proactive management of operational and liquidity risks becomes a central driver of value creation.

Keywords: Banking performance, Risk management, ARDL, Moroccan banks, Solvency, Prudential approach, Operational approach.

Paper type: Empirical research article

JEL Classification : G21, G32, C33

1. Introduction

In an increasingly volatile and competitive environment, banks face profound and recurring challenges. Ensuring medium and long-term sustainability requires a prudent and balanced approach to risk management, one that preserves profitability without compromising stability. In this context, robust financial performance combined with sound risk control serves as a stabilizing force, enabling institutions to absorb shocks that might otherwise escalate into systemic crises.

History has repeatedly demonstrated that when risk management is misaligned with real economic conditions, the consequences can be severe. The 2008 global financial crisis remains the most prominent example, where imprudent banking practices and excessive risk-taking fueled widespread instability. Numerous studies have underscored how the pursuit of short-term gains and unchecked risk appetite contributed to the crisis, reinforcing the need for risk governance that aligns performance objectives with prudent oversight.

Over time, risk management strategies in the banking sector have evolved along two complementary dimensions: the prudential approach, driven by regulatory frameworks such as the Basel Accords, emphasizes capital adequacy and risk-weighted asset requirements (Basel Committee on Banking Supervision, 2011); and the operational approach, which seeks to embed risk considerations into day-to-day decision-making processes and internal governance structures (Mikes, 2011). As noted by Liu and Wilson (2010), competitive pressure may lead managers to adopt lenient credit standards in the short term, potentially undermining long-term profitability. Thus, the relationship between risk management and bank performance remains a key area of academic and professional inquiry.

From a theoretical standpoint, this research is anchored in three complementary frameworks. Agency theory (Jensen & Meckling, 1976) explains how conflicts of interest may drive excessive risk-taking when managerial goals are misaligned with those of shareholders or regulators. The resource-based view (RBV) (Barney, 1991) considers internal risk control mechanisms as valuable resources that can enhance long-term performance. Lastly, regulation theory (Stiglitz, 1993) justifies prudential oversight as a corrective mechanism to address market failures and prevent systemic risks. Together, these theories frame risk management as both a governance issue and a strategic asset for value creation.

Within this framework, the present study examines the extent to which integrated risk management (combining prudential and operational approaches) enhances the financial performance of Moroccan commercial banks. Specifically, the research seeks to answer the following question: ***To what extent does effective risk management « combining prudential and operational dimensions » impact the financial performance of Moroccan banks?***

To address this question, the study adopts a twofold methodology. First, it conducts a conceptual analysis of the theoretical relationship between risk management and bank performance. Second, it implements an empirical investigation using a panel data model based on the Autoregressive Distributed Lag (ARDL) approach, applied to a sample of major Moroccan commercial banks. This approach is particularly suited to small samples with a mix of stationary and non-stationary variables and allows for distinguishing between short-run adjustments and long-run equilibrium effects.

2. Risk Management and Banking Performance: Literature Review

2.1. Risk Management: The Cornerstone of Banking Activity

Risk management lies at the heart of modern banking, shaping its institutional structure, operational functions, and long-term development. From the outset, banking activity has revolved around managing the uncertainties inherent in transforming savings into credit and,

more broadly, facilitating financial intermediation. As established by Gurley and Shaw (1956, 1960), Goldsmith (1958), and Tobin and Brainard (1963), financial intermediation emerged as a response to market imperfections and information asymmetries. Initially, surplus and deficit agents interacted directly in financial markets. However, risks related to default and illiquidity quickly revealed the limits of this disintermediated model (Gurley & Shaw, 1960).

To address these shortcomings, financial intermediaries began transforming the primary financial claims of deficit agents into more liquid and secure instruments. This evolution enabled them to absorb credit, liquidity, and market risks. Over time, these institutions developed from simple maturity and risk transformers into complex "market intermediaries," involved in securitization, brokerage, and speculative activities (Diamond & Dybvig, 1983; Adrian & Shin, 2010; Gorton & Metrick, 2012; Pozsar et al., 2013; Allen & Gale, 2004).

While financial intermediation remains critical for funding the real economy, it also exposes banks to a wide spectrum of risks: including credit, liquidity, market, operational, legal, and systemic risks. The intermediation theory extended by Bhattacharya and Thakor (1993) provides a valuable analytical framework for understanding the relationships between risk management, incentives, transparency, and performance. These theoretical advances highlight the fundamental trade-offs that shape contemporary banking practices.

Over the past few decades, risk management models have undergone profound transformations. Moving beyond the linear frameworks of early theorists, banks have adopted more integrated, multidimensional, and dynamic approaches. This shift has been driven by governance innovations, internal incentive systems, the increasing complexity of financial products, and heightened exposure to exogenous shocks. The 2008 global financial crisis marked a turning point. It exposed deep systemic fragilities: excessive leverage, regulatory blind spots, and persistent failures in transparency and internal controls (Brunnermeier, 2009). In response, international regulatory bodies such as the Basel Committee (BCBS, 2013) and the Bank for International Settlements (BIS, 2011) initiated comprehensive reforms to strengthen prudential oversight. These reforms highlighted the limits of purely operational approaches and underscored the strategic importance of the prudential framework for ensuring financial stability.

As a result, risk management can no longer be viewed as a purely technical or back-office function. It has become a strategic, cross-cutting, and integrated pillar of corporate governance. It plays a critical role not only in driving financial performance but also in safeguarding the long-term resilience and stability of banks in an increasingly complex, volatile, and interconnected global environment.

2.2. Risk Management: Between the Prudential and Operational Approaches

Bank risk management operates along two complementary dimensions: the prudential approach, shaped by international regulatory standards aimed at ensuring systemic stability, and the operational approach, which relies on institution-specific internal control mechanisms. This dual structure is grounded in several theoretical frameworks: regulation theory (Stiglitz, 1993), which justifies prudential oversight as a response to market failures; agency theory (Jensen & Meckling, 1976), which underscores managerial incentives for risk-taking; and the Resource-Based View (Barney, 1991), which highlights the strategic value of integrated risk management systems. The synergy between these two approaches is crucial to building a comprehensive risk framework that reconciles regulatory compliance with internal efficiency to support sustainable growth.

The prudential approach is driven by rules imposed by supervisory authorities (central banks, regulatory bodies, Basel Committees), with the aim of reinforcing financial institutions' resilience against adverse shocks. The Basel Accords (I, II, III, and more recently Basel IV) form the backbone of this framework, setting minimum standards for capital adequacy,

liquidity, and leverage. These standards pursue a dual objective: limiting systemic risk and protecting depositors (BCBS, 2011).

Regulation theory provides the rationale for this approach by viewing prudential norms as corrective mechanisms for market imperfections (Stiglitz, 1993). It aims to reduce information asymmetries and constrain opportunistic behaviors in a sector where risks can be hidden or transferred throughout the system. The regulatory framework is structured around three pillars:

- **Pillar I** – risk-weighted capital requirements,
- **Pillar II** – effective supervisory review,
- **Pillar III** – market discipline through transparency and disclosure.

Key instruments include the Tier 1 capital ratio, leverage ratio, liquidity coverage ratio (LCR), net stable funding ratio (NSFR), and regular stress testing for systemically important financial institutions.

In contrast, the operational approach refers to the internal mechanisms through which banks identify, assess, monitor, and mitigate risks affecting their assets, processes, systems, or human capital. Unlike the prudential approach, it extends beyond regulatory compliance to focus on operational security, efficient capital allocation, and sustained financial performance. This approach aligns with the Resource-Based View (Barney, 1991), which argues that competitive advantage arises from unique, hard-to-replicate internal capabilities. A well-integrated risk management system can thus become a strategic asset for long-term differentiation and performance.

Operational tools include risk mapping, key risk indicators (KRIs), internal risk limits (e.g., VaR, scenario analysis), internal control and audit systems, and incident reporting mechanisms. Moreover, risk culture is increasingly recognized as a critical intangible resource that underpins the long-term effectiveness of these mechanisms (Fraser & Simkins, 2016).

Although distinct, the two approaches are mutually reinforcing. The prudential framework provides a standardized foundation, while the operational approach enables more tailored, performance-driven implementation. However, agency theory (Jensen & Meckling, 1976) highlights a potential tension: managerial incentives may lead to excessive risk-taking to maximize shareholder returns, thereby undermining institutional and systemic stability. In this context, prudential regulation acts as an external disciplinary mechanism, while operational risk systems serve as internal controls to reduce information asymmetries.

Finally, systemic risk theory emphasizes that weaknesses in risk management, even within a single institution, can produce negative externalities that cascade across the financial system. An integrated approach is therefore essential not only for optimizing individual bank performance but also for safeguarding the collective stability of the banking sector (Acharya et al., 2010).

2.3. The Relationship Between Prudential and Operational Risk Management and Bank Performance: an empirical review

2.3.1 Credit Risk – Portfolio Quality and Cost

In terms of credit risk, empirical studies consistently report a negative association between non-performing loan (NPL) ratios or the cost of credit risk and bank profitability. This relationship has been confirmed across various contexts, including European banks (Laporšek et al., 2024), Chinese banks (Isanzu, 2017), and Nigerian banks (Saeed & Zahid, 2016). Louzis et al. (2012) further validate this effect in the Eurozone.

H1: *Deterioration in credit portfolio quality (measured by the NPL ratio) significantly reduces banking performance.*

H2: *A high net loan loss provisioning expense (cost of credit risk) has a significant negative impact on profitability.*

2.3.2 Liquidity Risk

Liquidity risk, by contrast, produces more mixed results. In the MENA region, active and controlled management of the loan-to-deposit (LTD) ratio has been linked to improved profitability (Khalaf & Awad, 2024). However, regional differences remain: a comparative study finds that the impact of capital and liquidity on profitability is negative for U.S. banks but positive for Asian banks (Abbas et al., 2019).

H3: Proactive liquidity risk management (captured by the loan-to-deposit ratio) enhances financial performance.

2.3.3 Operational Risk

The impact of operational risk remains more heterogeneous, reflecting differences in internal governance and risk control frameworks. In contexts such as Nigeria and Morocco, rising operational risk levels are significantly associated with declining profitability (Fadun, 2020; Chemlal & Benazzou, 2020; Tahraoui & Achibane, 2021).

H4: Adequate capital allocation to cover operational risk positively and significantly influences financial performance.

2.3.4 Market Risk

Market risk generally tends to undermine performance. In the MENA region, Bani Youssef & Al-Khasawneh (2023) find a significant negative relationship between exchange rate risk and bank profitability. Similarly, the FDIC's *Risk Review* (2024) reports that, in the U.S., rising market sensitivity and valuation losses on securities portfolios have eroded net interest margins amid increased deposit costs.

H5: Increased exposure to market risk is associated with lower banking performance.

2.3.5 Capital Adequacy – Solvency Ratio

From a prudential perspective, capital requirements under Basel III are designed to enhance the resilience of the banking system. Empirical evidence from the European Union shows that higher capital buffers are positively associated with bank profitability (Laporšek et al., 2024). Similar findings have emerged from studies on emerging markets, where banks with stronger capital positions prior to the COVID-19 crisis achieved better performance during 2019–2020 (Alkhazali et al., 2024). However, earlier research highlights potential trade-offs, suggesting that excess capitalization may temporarily compress return on equity (ROE) (Molyneux & Thornton, 1992; Demirgüç-Kunt & Detragiache, 1998).

H6: Compliance with solvency requirements (Tier 1 ratio) has a positive and significant effect on profitability.

2.3.6 Integrated Approach

Integrated risk governance is emerging as a strategic driver of performance. Studies show that enterprise risk management (ERM) frameworks and strengthened governance structures can enhance bank performance, particularly in emerging markets (Akbaş, 2024; Youssef, Taha & Muhmad, 2023).

H7: An integrated risk management approach, combining prudential and operational dimensions, improves overall bank performance.

Overall, although each risk category exerts distinct and, at times, ambivalent effects on profitability, the convergence of empirical findings underscores a shared imperative: the need for well-calibrated, context-sensitive risk management frameworks that reflect both macro-financial dynamics and the prevailing regulatory environment. In light of these insights, the following section presents our empirical investigation into the impact of risk management on the performance of major Moroccan commercial banks.

3. Methodology

Building on the theoretical foundations and empirical insights discussed above, this section presents an econometric investigation of the relationship between risk management practices and bank performance in the Moroccan context. The analysis employs a panel ARDL (Autoregressive Distributed Lag) model applied to a dataset of large conventional commercial banks.

3.1. Study Context and data description

The study focuses on a balanced panel of six major Moroccan commercial banks: Attijariwafa Bank, Banque Populaire, BMCE Bank of Africa, BMCI, CIH, and Crédit du Maroc, over the period 2010 to 2024. Sample selection was based on three criteria:

- i. Continuity and availability of financial data
- ii. Systemic importance within the national banking system
- iii. Representativeness in terms of total assets and market share

Data were sourced from the banks' published annual reports, specifically the consolidated balance sheets and income statements. Regulatory indicators introduced under Basel III: such as the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR), were excluded due to inconsistent disclosure prior to 2016. To ensure comparability and avoid missing observations, only variables reported consistently across the entire period were retained, yielding a balanced panel of 90 bank-year observations (6 banks × 15 years). All estimations were performed using STATA version 19.0.

3.2. Model Specification and Variables definition

This section presents the econometric framework and details the variables employed to assess the dynamic relationship between bank performance and various dimensions of risk management. The analysis adopts a panel Autoregressive Distributed Lag (ARDL) model, which is particularly suited for capturing both short-term dynamics and long-term equilibrium relationships in panel data settings.

3.2.1 Model Equation

The general form of the model is specified as follows:

$$y_{it} = \alpha + \beta x_{it} + \varepsilon_{it} ; t=1, \dots, T$$

Where:

- y_{it} denotes the dependent variable: net income (proxy for bank performance),
- x_{it} is a vector of explanatory variables capturing key dimensions of risk management,
- ε_{it} represents the stochastic error term, accounting for both individual and time-specific effects

To operationalize the model empirically, the equation is expanded to integrate specific risk indicators as follows:

$$RTNET_{it} = \alpha_{it} + \beta_1 LTDx_{it} + \beta_2 RM_{it} + \beta_3 RO_{it} + \beta_4 CtR_{it} + \beta_5 NPL_{it} + \beta_6 SOLV_{it} + \varepsilon_{it}$$

Where :

- i indexes the cross-sectional unit (the 6 commercial banks),
- t refers to the time period (2010–2024)

3.2.2 Definition of Variables

➤ Dependent Variable

Net Income (RTNET): The logarithm of net income is employed as a comprehensive proxy for bank performance. This global accounting measure encapsulates the cumulative effect of

operational efficiency, risk exposure, and strategic decisions, and is widely used in performance analysis.

➤ Explanatory Variables

The model incorporates variables representing four core dimensions of risk management:

Liquidity Risk:

- Loan-to-Deposit Ratio (LTD): Measures liquidity risk by assessing the extent to which loans are funded by customer deposits. A moderate LTD is associated with efficient intermediation, whereas excessively high values may indicate funding fragility during stress periods (van den End, 2013; Yeasin, 2023).

Credit Risk:

- Non-Performing Loans Ratio (NPL_RATIO): Captures the ex-post quality of the loan book.
- Cost of Risk (COUT_R): Reflects forward-looking provisioning for potential credit losses. Together, these indicators provide a dual (retrospective and anticipatory) perspective on credit risk exposure, in alignment with the empirical literature.

Operational Risk:

- Capital Requirement for Operational Risk (log_Capital_OP): A prudential proxy derived from regulatory frameworks (Basel II/III), representing capital set aside to absorb losses from operational failures.

Market Risk:

- Risk-Weighted Assets for Market Risk (log_RWA_Market): Expressed in logarithmic form, this variable quantifies exposure to market volatility and the corresponding capital charges under prudential regulations.

➤ Control Variable

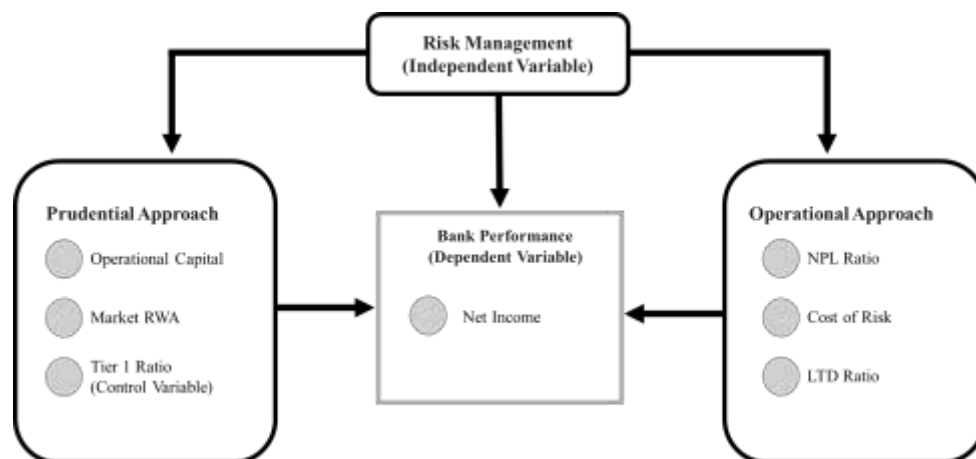
Solvency Risk:

- Tier 1 Capital Ratio (RATIO_Tier1): Included to control for variations in solvency and capital adequacy among banks. This ratio reflects the institution's ability to absorb losses and maintain market confidence. Its inclusion addresses heterogeneity in capital structure, consistent with findings that link capitalization more to institutional resilience than to direct profitability (Abou El Sood, 2016).

3.2.3 Conceptual Model

A complete summary of the variables included in the model is provided in the figure below (figure)1:

Figure 1 : Conceptual Framework: Relationship Between Risk Management and Bank Performance



Source: Authors

3.3. Data Treatment and Estimation Strategy

This section outlines the statistical procedures and econometric estimation strategy used to validate the model and analyze the relationship between risk management indicators and bank performance.

3.3.1 Descriptive Statistics

The descriptive statistics (Table 1) of the variables indicate non-zero standard deviations, reflecting substantial variation both across time and between banks. This variability supports the adoption of a dynamic panel framework and further reinforces the relevance and robustness of the empirical design.

Table 1 : Descriptive Statistics of the Panel Data Variables

Variable	Obs	Mean	Std. dev.	Min	Max
Log_RNT	90	13.68666	1.033336	10.40357	15.7521
TIER1_RATIO	90	.1063122	.0114044	.0873	.142
Log_Capita_Op	90	13.6808	.9597336	11.23975	15.19826
Log_RWA_Market	90	14.79844	1.840809	11.51293	17.46065
RATIO_LTD	90	1.071119	.2469816	.7837016	1.697372
NPL_RATIO	90	.0253889	.0090941	.0056	.0452
COST_R	90	.0134305	.0131687	-.0047619	.0618584

Source : Authors' «calculations based on results obtained using STATA»

3.3.2 Multicollinearity Test

As an initial diagnostic, multicollinearity among the explanatory variables was assessed using the Variance Inflation Factor (VIF) test (Table 2).

Table 2 : Variance inflation factors (VIF)

Variable	VIF	1/VIF
Log_RWA_Market	5.82	0.171835
Log_Capita_Op	5.15	0.194148
COUT_R	2.11	0.474219
LTD_RATIO	1.84	0.544678
NPL_RATIO	1.42	0.706482
TIER1_RATIO	1.13	0.886453
Mean VIF	2.91	

Source : Authors' «calculations based on results obtained using STATA»

Following the conventional rule of thumb, multicollinearity becomes problematic when the VIF exceeds the critical threshold of 10. The test results show that all explanatory variables exhibit VIF values well below this limit, thereby ruling out the presence of severe multicollinearity.

3.3.3 Unit Root Test (Stationarity)

Next, a Fisher-Phillips-Perron (Fisher-PP) panel unit root test was performed to determine the order of integration of the variables and to guide the econometric specification (Table 3).

The results reveal that several variables are stationary at level, $I(0)$: namely, net income (the proxy for bank performance), operational risk, market risk, and the net cost of credit risk. In contrast, the remaining variables, specifically the Tier 1 capital ratio (solvency), the loan-to-deposit ratio (LTD) (liquidity risk and asset-liability management), and the non-performing loan (NPL) ratio (credit risk), were found to be stationary at first difference, $I(1)$. These results satisfy the first key condition for applying the panel ARDL model, which requires a combination of variables integrated of order $I(0)$ and $I(1)$, but none integrated of order $I(2)$.

Table 3 : Fisher–Phillips–Perron Panel Unit Root Test

	Fisher–Phillips–Perron (Fisher-PP) Panel Unit Root Test				Order of Integration
Variables	Level		First difference		
	Test statistic	p-value	Test statistic	p-value	
Log_RNT <i>Log(Net Income)</i>	3.4498	0.0003	-----	-----	I(0)
RATIO_TIER1	0.5557	0.2892	10.8154	0.0000***	I(1)
Log_Capita_Op	13.0210	0.0000	-----	-----	I(0)
Log_RWA_Market	13.9301	0.0000***	-----	-----	I(0)
COST_R	54.6640	0.0000***	-----	-----	I(0)
RATIO_LTD	17.5791	0.1291	86.0895	0.0000***	I(1)
NPL_RATIO	16.6879	0.1617	66.3380	0.0000***	I(1)
<i>Note: (***), (**), (*) indicate stationarity at the 1%, 5%, and 10% thresholds, respectively, according to the Phillips-Perron Fisher test. Rejection of the null hypothesis implies that the variable is stationary.</i>					

Source: Authors' «calculations based on results obtained using STATA»

3.3.4 Cointegration Tests

Furthermore, cointegration tests were conducted to verify the existence of long-run relationships between bank performance and the explanatory variables. Both the Kao and Pedroni tests confirmed the presence of such relationships, with p-values consistently below the 5% significance threshold. These findings validate the suitability of the panel ARDL specification and justify the estimation of both short-run and long-run dynamics in the subsequent analysis (Table 4).

Table 4 : Results of the Pedroni and Kao Cointegration Tests

Tests		T-Statistic	P-value
Pedroni	Modified Phillips Perron t	3.0676	0.0011***
	Phillips-Perron t	-2.6283	0.0043
	Augmented Dickey-Fuller t	-2.1289	0.0166**
Kao	Modified Dickey-Fuller t	-1.0053	0.1574
	Dickey-Fuller t	-2.7689	0.0028
	Augmented Dickey-Fuller t	-0.7503	0.2265
	Unadjusted modified Dickey-Fuller t	-5.8796	0.0000***
	Unadjusted Dickey-Fuller t	-5.0779	0.0000
<i>Note: (***) , (**), and (*) denote statistical significance at the 1%, 5%, and 10% levels, respectively. Rejection of the null hypothesis of no cointegration ($p < \text{significance level}$) indicates the existence of a long-run cointegration relationship among the variables, according to the Pedroni and Kao tests.</i>			

Source : Authors' «calculations based on results obtained using STATA»

3.3.5 Estimation Results

To examine the relationship between bank performance and risk management, we conducted an empirical analysis covering a 15-year period (2010–2024) for a balanced panel of six Moroccan banks. The Autoregressive Distributed Lag (ARDL) model was selected for its methodological flexibility: it accommodates variables with mixed orders of integration (I(0) and I(1)), performs well with relatively small panels, and allows the joint estimation of both short-run dynamics and long-run equilibrium relationships within a unified framework.

While applying the panel ARDL approach, the selection of an appropriate estimator is critical. Among the three main alternatives, the Mean Group (MG), Dynamic Fixed Effects (DFE), and Pooled Mean Group (PMG) estimators, the PMG estimator proposed by Pesaran, Shin, and Smith (1999) was deemed the most suitable for this study. Econometrically, this approach constrains long-run coefficients to be homogeneous across banks, capturing the influence of common structural and regulatory factors, while allowing short-run dynamics to vary across institutions. Economically, this assumption is consistent with the Moroccan banking context,

where a unified prudential framework ensures long-run convergence, but short-term adjustments differ due to variations in risk exposure, strategic orientation, and operational practices (Table 5).

Table 5: Estimation Results of the Panel ARDL Model Using the Pooled Mean Group (PMG) Estimator

Estimation method: Pooled Mean Group (PMG) estimator Cross-sectional dimension: 6 banks Time dimension: 15 years (2010–2024)					
Variable	Coefficient	Std. Error	z-statistic	p-value	95% Confidence Interval
Dependent variable	Logarithm of net income (log_rnt) ; proxy for bank performance				
Long-run coefficients					
RATIO_TIER1	1.995359	3.389083	0.59	0.556	[-4.64717; 8.637736]
Log_Capita_Op	1.288644	0.111469	11.56	0.000	[1.072211; 1.507076]
Log_RWA_Market	0.000593	0.954769	0.01	0.991	[-1.866555; 1.787216]
RATIO_LTD	1.447552	0.318649	4.54	0.000***	[0.823112; 2.072094]
NPL_RATIO	-3.247368	3.449266	-0.94	0.34	[-10.0878; 3.513469]
COST_R	-47.99791	7.713344	-6.22	0.000	[-63.11579; -32.88083]
Short-run coefficients					
ECT (_ec)	-0.9167451	0.2466597	-3.72	0.000***	[-1.400189; -0.4333009]
D. RATIO_TIER1	-4.470213	7.062686	-0.63	0.527	[-18.31282; 9.372398]
D. Log_Capita_Op	1.727598	2.191787	0.79	0.431	[-2.568225; 6.023421]
D. Log_RWA_Market	-0.0443751	0.0803926	-0.55	0.581	[-0.2019417; 0.1131916]
D. RATIO_LTD	-3.385543	2.010438	-1.68	0.092	[-7.325929; 0.554843]
D. NPL_RATIO	-6.317135	19.60167	-0.32	0.74	[-44.73571; 32.10144]
D. COST_R	5.043909	16.68647	0.30	0.762	[-27.66097; 37.74879]
Constant	-4.732933	1.260222	-3.76	0.000***	[-7.202924; -2.262943]
Note: (*), (**), (***) denote statistical significance at the 10%, 5%, and 1% levels, respectively.					

Source : Authors' «calculations based on results obtained using STATA»

Following the estimation of the ARDL–PMG model, the error-correction coefficient was found to be negative (−0.9167) and highly significant ($p < 0.001$). This indicates that, when short-term disequilibria occur, approximately 91.7% of the deviation from the long-run equilibrium is corrected within one period. Such a high speed of adjustment highlights the strength of the convergence mechanism and provides robust evidence of a long-term cointegrating relationship between bank performance and the identified risk management variables.

3.3.6 Model Diagnostics

To further assess the statistical soundness of the model, diagnostic tests were conducted. The Jarque–Bera normality test yielded a p-value of 0.1466, supporting the null hypothesis of normally distributed residuals. This result confirms the adequacy of the model specification and the robustness of the estimated coefficients, see Table below (Table 6).

Table 6 : Results of the Jarque–Bera Normality Test for Residuals

Statistic	P-value
3.84	0.1466

Source : Authors' «calculations based on results obtained using STATA»

4. Results

The analysis of the long-run coefficients yields several noteworthy insights.

First, the logarithm of operational capital requirements (log_Capital_OP) exhibits a positive and highly significant coefficient (1.2886; $p < 0.001$). This finding suggests that a 1% increase in operational capital is associated with an approximate 1.29% rise in bank profitability over

the long run. In the Moroccan context, this underscores the strategic importance of investments in internal control systems, compliance mechanisms, and risk management frameworks, as these ultimately strengthen institutional performance. This result validates Hypothesis H4 and aligns with Bani Yousef et al. (2023), who documented a significant positive relationship between operational risk management and bank performance in the MENA region (Journal of International Studies).

Similarly, the loan-to-deposit ratio (LTD), a key indicator of intermediation efficiency, shows a positive and statistically significant effect (coefficient = 1.4476; $p < 0.001$). A higher LTD ratio reflects more effective transformation of deposits into loans, thereby enhancing profitability. This finding highlights the central role of asset–liability management (ALM) in the Moroccan banking model, where performance remains closely linked to the sector’s core function of financing the real economy. This result confirms Hypothesis H3 and corroborates Bourke (1989) and Athanasoglou et al. (2008), who emphasize the importance of intermediation and ALM efficiency as key determinants of bank profitability.

By contrast, the net cost of risk (COUT_R) displays a negative and highly significant coefficient (-47.9971 ; $p < 0.001$), confirming that higher provisioning for loan losses significantly reduces profitability. While these provisions enhance balance-sheet resilience by absorbing expected losses, they simultaneously constrain current earnings. This result validates Hypothesis H2 and supports Dietrich and Wanzenried (2011), who found similar evidence for Swiss banks (Journal of International Financial Markets, Institutions and Money).

Interestingly, certain prudential indicators traditionally viewed as relevant drivers of performance, namely, the Tier 1 capital ratio and market risk-weighted assets (RWA_Market), do not exhibit statistically significant effects. Consequently, Hypothesis H6 is not supported: capital adequacy, while crucial for solvency and stability, does not directly influence profitability. This finding is consistent with Pasiouras and Kosmidou (2007), who observed that regulatory capital enhances resilience but does not systematically explain profitability (Journal of Business Finance & Accounting). Similarly, Hypothesis H5 is not validated: exposure to market risk does not significantly affect performance. Although the coefficient on market RWA is positive, it remains statistically insignificant—reflecting the relatively limited role of market-based activities in the Moroccan banking model. This aligns with Demirgüç-Kunt and Huizinga (1999), who found that, in emerging banking systems, profitability is primarily driven by intermediation rather than by market-related operations (World Bank Policy Research Working Paper).

Furthermore, the non-performing loan ratio (NPL_RATIO) is found to be statistically insignificant. Although the coefficient has the expected negative sign, its effect appears to be absorbed by the net cost of risk variable, which captures provisioning behavior more directly. As a result, Hypothesis H1 is not confirmed. This outcome likely reflects conservative provisioning policies that mitigate the direct impact of NPLs on profitability, a phenomenon also observed by Louzis, Vouldis, and Metaxas (2012) in their study of Greek banks (Journal of Banking & Finance).

Taken together, the results indicate that Hypothesis H7 is only partially validated. While an integrated risk management framework enhances bank performance, its influence is asymmetric across dimensions. Specifically, credit risk, liquidity risk, and operational risk exert significant effects on profitability, whereas solvency and market risk indicators do not directly shape performance outcomes.

Table 7: Summary of Empirical Results

Variable	Effect	Significance	Hypothesis	Finding	Similar references
Operational risk (Log_Capita_Op)	Positive (1.2886)	Significant *** (p < 0.001)	H4	Operating capital enhances profitability through control and compliance mechanisms.	Bani Yousef et al. (2023)
Liquidity risk/GAP (LTD_RATIO)	Positive (1.4476)	Significant *** (p < 0.001)	H3	Intermediation (ALM) contributes significantly to bank profitability.	Bourke (1989), Athanasoglou et al. (2008)
Credit risk (COST_R)	Negative (-47.9971)	Very significant *** (p < 0.001)	H2	The high cost of risk worsens net income despite better loss coverage.	Dietrich & Wanzenried (2011)
Solvency risk (RATIO_TIER1)	Positive (1.9954)	NS ((p = 0.556)	H6: Not confirmed	Solvency is not a direct driver of banking performance.	Pasiouras & Kosmidou (2007)
Market risk (Log_RWA_Market)	Positive	NS (p = 0.991)	H5: Not confirmed	Market risk does not significantly impact profitability in the Moroccan context.	Demirgüç-Kunt & Huizinga (1999)
Credit risk (NPL_RATIO)	Negative (-3.2474)	NS (p = 0.346)	H1: not validated	The effect of non-performing loans is absorbed by prudent provisioning.	Louzis, Vouldis & Metaxas (2012)
Integrated approach	-----	-----	H7: Partially confirmed	Only certain risk drivers influence performance (operational, credit, liquidity).	

Source : Authors' «calculations based on results obtained using STATA»

5. Discussion

The estimation of the ARDL–PMG model provides additional evidence on the relationship between risk management and bank performance in the Moroccan context.

- ***Prudential risk management: well established but not fully leveraged***

The Tier 1 capital ratio, reflecting the strength of regulatory capital, exerts a positive but statistically insignificant effect on profitability. This suggests that Moroccan banks remain adequately capitalized in line with Basel III standards and Bank Al-Maghrib's supervisory requirements. However, excess capital has not yet been mobilized as an active profitability driver. In other words, Moroccan banks pursue a conservative capital policy that enhances systemic stability but is not monetized as a source of performance. This finding reflects a management orientation centered on resilience rather than aggressive commercial expansion.

- ***Credit risk: the most binding constraint on performance***

The pivotal role of credit risk is again confirmed. Lending remains both the engine and the «Achilles' heel» of bank profitability. The net cost of risk exerts a strong, negative, and highly significant effect, making it the single most detrimental factor for performance. By contrast, the NPL ratio, although negatively signed, is statistically insignificant—indicating that asset-quality deterioration is contained, albeit at the cost of substantial provisioning. Overall, Moroccan banks manage their loan portfolios prudently; however, credit risk remains structurally high, weighing persistently on profitability despite conservative provisioning strategies.

- ***Operational risk management as a value-creating lever***

The operational risk capital requirement shows a positive and significant impact on net income. This underscores that investments in internal controls, compliance systems, digitalization, and

monitoring mechanisms enhance financial outcomes. It can therefore be inferred that the quality of operational governance constitutes a key differentiator of bank performance.

- ***Liquidity management: controlled and performance-enhancing***

he loan-to-deposit ratio (LTD), a central measure of liquidity transformation, exerts a positive and significant effect on profitability. This confirms that Moroccan banks benefit from robust asset–liability management (ALM), effectively mobilizing their stable deposit bases to maximize intermediation margins. Liquidity management thus represents a structural strength, reinforcing the resilience of the Moroccan universal banking model, firmly anchored in retail intermediation.

- ***Market risk remains peripheral to the banking model***

Market risk-weighted assets (RWA) display a positive but non-significant coefficient. This finding confirms that market activities are not yet a major source of profitability for Moroccan banks, unlike in more advanced financial systems. The modest contribution of market risk likely reflects strategic positioning and regulatory constraints. While this conservative orientation supports systemic stability, it also limits diversification and the development of alternative income sources.

6. Policy and Managerial Recommendations

Building on these findings, several recommendations can be formulated to strengthen risk management practices and enhance the financial performance of Moroccan banks:

- ***Leverage regulatory capital more strategically***

Banks should view regulatory capital not only as a compliance buffer but also as a profitability lever. This requires optimizing capital allocation toward assets with the highest risk-adjusted returns, adopting indicators such as Regulatory Capital Return, and considering hybrid instruments (e.g., AT1 capital) to increase flexibility while maintaining Basel III compliance.

- ***Strengthen credit risk management***

As credit risk remains the most critical constraint, banks should reinforce internal rating frameworks, adopt advanced scoring models integrating behavioral data, and enhance proactive borrower monitoring. Gradual progress toward Internal Ratings-Based (IRB) approaches, under Bank Al-Maghrib's supervision, would improve the precision of risk measurement and the efficiency of provisioning.

- ***Consolidate operational risk management as a performance driver***

Since operational risk management is positively linked to profitability, banks should intensify investments in governance, risk, and compliance (GRC) systems, accelerate process digitalization, and foster a strong risk-aware culture at all organizational levels.

- ***Optimize liquidity management and intermediation***

Given the central role of intermediation, banks should continue refining ALM strategies, improve risk pricing liquidity, and deploy advanced forecasting and stress-testing tools. The development of long-term savings products could further stabilize funding sources and reduce structural mismatches.

- ***Gradually strengthen market risk management***

Although currently marginal, market risk management should not be neglected. Banks could progressively build expertise in securities portfolio management, interest rate, and foreign

exchange risk, using robust yet simple tools (e.g., Value-at-Risk, stress testing, duration analysis), while maintaining a prudent risk profile.

- ***Promote transparency and regulatory dialogue***

Enhancing disclosure of risk indicators would strengthen market discipline and stakeholder confidence. A deeper and continuous dialogue with regulators could facilitate the adoption of advanced Basel approaches tailored to the Moroccan context. In parallel, greater engagement in digital innovation and fintech partnerships would help diversify revenue sources, enhance agility, and sustain competitiveness in an evolving financial landscape.

7. Conclusion

The Moroccan banking sector, as a central pillar in financing the national economy, operates within an environment increasingly defined by the dual imperatives of profitability and prudential soundness. This study sought to examine, through an integrated analytical framework, the differentiated impact of prudential and operational risk management levers on the financial performance of Moroccan banks.

From an empirical perspective, the analysis was conducted on a balanced panel of six major commercial banks over a fifteen-year period (2010–2024), using an ARDL model estimated via the Pooled Mean Group (PMG) method. This methodological choice proved particularly appropriate, as it captured both short- and long-term dynamics within a mixed-stationarity framework while accounting for regulatory convergence and institutional heterogeneity. The results confirm the existence of a structural and long-term relationship between risk management and bank performance, consistent with the strategic logic of credit institutions pursuing sustainable value creation.

The findings reveal an asymmetry in the contribution of different risk management dimensions. On the operational side, three major insights emerge:

- (i) the effectiveness of asset–liability management (ALM), proxied by the loan-to-deposit ratio (LTD), is a key determinant of profitability;
- (ii) the net cost of risk constitutes the most binding constraint on performance; and
- (iii) investments in operational controls and governance frameworks exert a positive and significant influence on profitability.

Together, these findings emphasize the pivotal role of credit, liquidity, and operational risks in shaping bank performance, in line with international empirical evidence.

Conversely, traditional prudential indicators, such as the Tier 1 capital ratio and market risk-weighted assets, do not exert significant effects on profitability. This suggests that, within the Moroccan banking model, solvency functions more as a foundation for stability than as a direct performance driver, while market-based activities remain peripheral. This configuration reflects a conservative intermediation-centered model, effective in preserving systemic stability but still limited in terms of revenue diversification.

Accordingly, this research makes a dual contribution. Academically, it enriches the literature on banking governance in emerging contexts by demonstrating that performance is primarily driven by operational discipline rather than by prudential capital buffers. Managerially, it provides actionable insights: strengthening credit risk assessment and provisioning frameworks, investing in integrated risk management systems, modernizing ALM practices, and diversifying income sources beyond traditional lending. For regulators, the results highlight the importance of promoting transparency, encouraging prudent innovation, and supporting the gradual adoption of advanced Basel approaches adapted to the Moroccan context.

Certain limitations must, however, be acknowledged. Although the sample is representative of the sector, its scope remains relatively limited. Moreover, the unavailability of certain

prudential indicators (e.g., LCR, NSFR, VaR) across the full observation period restricted the analysis of systemic and market risks. These limitations open avenues for future research, including the use of higher-frequency data, cross-country comparisons within the MENA region, and the exploration of how digital transformation and ESG factors affect the interplay between risk management and bank performance.

Ultimately, the performance of Moroccan banks today is anchored in strategic prudence and robust risk management frameworks. To evolve from a stability-focused model toward one that fosters sustainable and competitive growth, banks will need to activate new levers: capital optimization, operational agility, and financial innovation, to consolidate their position in a rapidly changing financial ecosystem.

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