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Analyzing the Impact of Risk Management Variables on Banking Mergers and Acquisitions: A Statistical Approach

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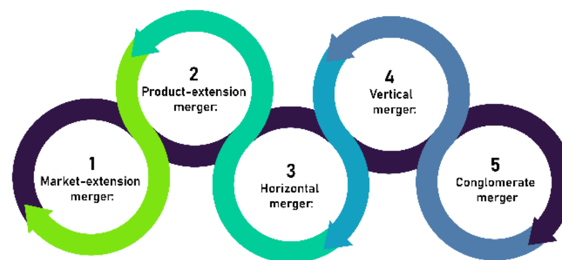
Abstract: Mergers and acquisitions (M&A) within the banking sector include intricate decision-making procedures shaped by many risk factors. Effective risk management is essential to guarantee the success of these transactions, considering the potential financial, operational, and market uncertainties. This study examines the influence of primary risk factors—market risk, credit risk, and operational risk—on the financial performance of banks involved in mergers and acquisitions. The study utilizes a comprehensive methodological framework and incorporates statistical methods such as correlation tests, regression analysis, ratio analysis, and paired t-tests to assess performance before and after the merger. The analysis examines the impact of risk variables on essential financial metrics, including profitability, asset quality, and stock performance, while evaluating the effectiveness of risk management measures in alleviating negative consequences. Ratio analysis is utilized to comprehend variations in financial stability, whereas paired t-tests assess significant alterations in performance indicators pre- and post-merger. By using these techniques, the study offers a comprehensive view of the correlation between risk management and the success of M&A deals. The findings seek to assist practitioners in recognizing and mitigating critical risk areas to improve M&A outcomes, providing significant insights to the domains of banking, finance, and strategic risk management.

Key words: Risk Management, Banking Mergers, Acquisitions, Risk Variables, Statistical Analysis, Financial Performance, Correlation Tests

1. Introduction

When it comes to staying competitive, expanding into new markets, and improving operating efficiencies in a highly regulated and ever-changing financial landscape, mergers and acquisitions (M&A) are the way to go for banks. Globalization, technical advancement, and shifting customer tastes have all contributed to a dramatic increase in banking industry mergers and acquisitions over the last several decades. While mergers and acquisitions (M&A) may have huge benefits in the long run, they are also notoriously difficult to pull off and fraught with financial, operational, and regulatory grey areas. Mergers and acquisitions in the banking industry rely heavily on risk management strategies. Secure long-term financial stability and effective integration depend on the ability to detect, assess, and mitigate risks, which in turn protect shareholder value. Banks can

achieve their strategic objectives, survive the inevitable storms that accompany mergers and acquisitions, and adapt to new circumstances with the help of effective risk management. Different kinds of risk, each with the potential to significantly impact the outcome of a transaction, are a major source of concern in banking mergers and acquisitions[1]. Assessment of assets and preparations for financing are both affected by market risk, which arises from factors including fluctuating interest rates, the state of the economy, and the stock market. The acquirer's borrowing costs may rise or the acquisition's expected profits may fall, for instance, if interest rates suddenly change. The confidence of stakeholders and the smooth running of decision-making procedures can both be shaken by unexpected economic shocks. Because loan portfolios can make up a sizable portion of a bank's balance sheet, credit risk is an important consideration for any financial institution. If the target institution has a high ratio of non-performing assets (NPAs), the acquirer may have trouble funding the merger. Therefore, they must evaluate the target institution's creditworthiness. The profitability and overall stability of the acquirer could be negatively affected by unexpected financial liabilities that result from poorly assessed and managed credit risk. In addition, the post-merger integration phase makes operational risk, which includes disruptions in internal processes, systems, and personnel, much worse[2]. Efficiency losses, damage to reputation, and legal trouble are all possible outcomes of integration concerns such as IT system consolidation, cultural alignment, and the retention of key personnel. The importance of risk management in bank mergers and acquisitions is well-known, but there is still a lack of research that quantifies the impact of certain risk variables on financial outcomes. Mergers and acquisitions are often studied from a macroeconomic or strategic perspective in current research, but little is known about the impact of individual risk factors on the success of these deals. The need for a more comprehensive and data-driven approach to studying banking risk management is underscored by this gap. If qualitative evaluations of risk factors are insufficient, quantitative analyses may show connections and patterns that would otherwise go undetected. For politicians and practitioners who want M&A plans to be more resilient and effective, these lessons are crucial[3].



[1]Adhikari, B., Kavanagh, M., & Hampson, B. (2023). The effect of mergers and acquisitions on the financial performance of commercial banks in Nepal. *Banks and Bank Systems, 18*(4), 74–84.
[2]Aggarwal, P., & Garg, S. (2022). Impact of mergers and acquisitions on accounting-based performance of acquiring firms in India. *Global Business Review, 23*(1), 218–236.

[3]Anand, M., & Singh, J. (2008). Impact of merger announcements on shareholders' wealth: Evidence from Indian private sector banks. *Vikalpa, 33*(1), 35–54.

Fig. 1 Types of Mergers and Acquisitions [21]

This study aims to fill that knowledge vacuum by investigating how market, credit, and operational risk, three essential management variables, affect the outcomes of bank mergers and acquisitions. The study employs a thorough statistical technique to examine the relationships between risk factors and financial performance metrics. This methodology includes paired t-tests, regression analysis, ratio analysis, and correlation testing. By comparing financial data from before and after a merger, this study hopes to shed light on how different risk factors affected profitability, asset quality, and shareholder value. While paired t-tests determine the importance of performance differential before and after a merger, ratio analysis sheds light on changes in financial stability. By comparing the relative importance of different risk variables, regression analysis helps to identify the major predictors and understand how they impact outcomes. Researchers hope that the findings will improve academic writing as well as real-world applications in the financial and banking industries[4]. This study aims to shed light on the correlation between effective risk management and financial outcomes for the benefit of investors, regulators, and banks involved in mergers and acquisitions. In order to help banks improve their risk assessment frameworks and deal with possible merger and acquisition (M&A) process difficulties, this paper provides evidence-based advice. Findings stress the importance of regulators enacting rules that encourage efficient risk management strategies, which boost financial system stability and confidence. The results show that investors need to look at some key factors to see if banking industry M&A deals would be sustainable in the long run. Risk management in bank mergers and acquisitions is of utmost importance during this time of economic uncertainty and increased regulatory scrutiny. The application of advanced statistical tools to the analysis of risk factors is a significant step forward in understanding the complexities of these intricate transactions. In order to help stakeholders tackle the challenges of banking mergers and acquisitions, this research provides a thorough and quantitative examination. To ensure the longevity and effectiveness of merger and acquisition strategies in the banking industry in the face of a changing financial landscape, it is essential to have a better understanding of risk management processes.

1.1 Background

In nations like India, where the banking industry has been experiencing heavy consolidation, banking mergers and acquisitions (M&As) play a crucial role in fortifying financial institutions. As a means to strengthen financial stability, improve competitive posture, and reduce the impact of non-performing assets (NPAs), numerous large-scale mergers have taken place in India in the past few years, mostly among PSBs. One goal of the bank mergers in India is to make the combined institutions stronger enough to weather the storms of economic volatility, credit risk, and international market rivalry. For PSBs in India, the government and regulatory agencies like the Reserve Bank of India (RBI) have supported mergers like these because they are seen as necessary measures to alleviate financial strain, capital constraints, and inadequate market share. An illustrative case in point was the 2020 announcement of the consolidation of ten PSBs into four bigger organizations. The financial sector relies on these mergers to combine resources, enhance lending capacity, and decrease operational inefficiencies. When evaluating the success of financial institutions after a merger and putting a number on the risks involved, statistical analysis is crucial. Researchers and practitioners can leverage statistical tools including paired t-tests, regression analysis, correlation testing, and ratio analysis to study the relationship between various risk characteristics and the merged institutions' financial outcomes. Key

[4]Darayseh, M., & Alsharari, N. M. (2023). Determinants of merger and acquisition in the banking sector: An empirical study. *Meditari Accountancy Research, 31*(4), 1093–1108.

financial measures like profitability, asset quality, and capital adequacycan be affected by risks like operational inefficiencies or credit defaults, and these tools can help you measure that impact[5].

1.2 Overview of Risk Management in Banking M&As

In order to keep the merged business stable, financially viable, and doing well in the long run, risk management is crucial in banking mergers and acquisitions (M&As). If not properly managed, the merger could cause financial instability, operational inefficiencies, or damage to the company's brand. Therefore, it is important to identify, analyze, and mitigate these risks. In banking, mergers and acquisitions are complex undertakings with many moving parts, each of which demands careful consideration.

Types of Risks in Banking M&As

1. Market Risk

Banks have market risk when they are vulnerable to changes in interest rates, currency exchange rates, and stock prices, among other financial market variables. When financial organizations with varied risk profiles combine, market risk becomes an especially important consideration. For example, after a merger, the profitability of loans and investments might be impacted by changes in interest rates. One example is the 2017 State Bank of India (SBI) merger, which highlighted the difficulties of coordinating various market exposures. The new, bigger SBI was vulnerable to interest rate fluctuations since the affiliate banks were all different in their degree of susceptibility to such changes. Similarly, the combined bank's exposure to worldwide markets could lead to foreign exchange risk, particularly if it has substantial international activities. The financial performance of the bank after a merger can be more unpredictable if market risk is not adequately controlled, according to studies. A study on banking mergers in India found that banks' capacity to remain profitable is significantly impacted by changes in interest rate risk and foreign exchange risk, especially in an unstable economic climate[6].

Parameters	Bank Baroda	Vijaya Bank	Dena Bank	Merged Entity
Total Business (Rs cr)	1029810	279575	172940	1482325
Deposits (Rs cr)	581485	157325	103020	841830
Gross Advances (Rs cr)	448330	122350	69920	640600
Employees	56360	15875	13440	85675
Branches (Domestic)	5502	2130	1858	9490
Deposite/Branch (Rs cr)	106	74	55	89
Advances/Branch (Rs cr)	81	57	38	68
RoA (%)	0.29	0.32	-2.43	-0.02
CET-1 Capital Ratio (%)	9.27	10.35	8.15	9.32
CRAR Capital Ratio (%)	12.13	13.91	10	12.25
Net NPA (%)	5.4	4.1	11.04	5.71
CASA Ratio (%)	35.52	24.91	39.8	34.06

Fig. 2 Bank of Baroda + Dena Bank + Vijaya Bank [22]

2. Credit Risk

[5]Gachigo, J., Ondigo, H., Aduda, J., & Onsomu, Z. (2023). Intervening role of risk management on the relationship between mergers and acquisitions and financial performance of commercial banks in Kenya. *African Development Finance Journal, 5*(1), 71–96.
[6]Ghosh, S., & Dutta, S. (2015). Mergers and acquisitions in Indian banking sector: Pre-post analysis of performance parameters. *International Organization of Scientific Research Journal of Business and Management, 17*(3), 1–9.

Loss that can occur as a result of debtors not paying their bills is known as credit risk. Banks that merge take on one other's loan portfolios, which could contain high-risk or non-performing loans. This is of utmost concern in India, where the public sector banking sector in particular has been hit hard by the increasing nonperforming assets (NPAs). One example is the 2019 Bank of Baroda–Dena–Vijaya Bank merger, where credit risk emerged as a major concern. In instance, the newly constituted bank may have been in jeopardy due to Dena Bank's high nonperforming asset (NPA) exposure. To maintain a solid credit profile after the merger, the combined organization had to revise its approaches to managing credit risk and clean up its asset books. Potential losses from poor loans are just one way in which credit risk impacts the merging bank. It also impacts the bank's capacity to draw in new customers and keep investors' faith. Research on the consolidation of India's public sector banks has shown that, following a merger, the health of the merged firm depends on how well its credit risk is managed[7].

3. Operational Risk

Mergers between financial institutions pose a risk to operations due to the difficulties in integrating various operational systems, processes, and technology. Inconsistencies in company culture, managerial styles, and information technology systems are all examples of what might go wrong. Mergers in India pose a higher operational risk due to the fact that many banks are still using outdated systems, which can cause major disruptions throughout the integration process. A prime illustration of this is the 2010 merger between ICICI Bank and Bank of Rajasthan, which encountered significant operational risk issues as a result of dissimilarities in IT systems, procedures, and company ethos. Disruptions to customer service and operational inefficiencies were brought about by the integration process, which had an impact on the bank's overall performance. Negligible management of operational risk might result in high expenses, lower customer satisfaction, and inefficiencies after the merger in the long run. According to research, operational risk ranks high among the obstacles that merging banks in India face while trying to integrate smoothly. The merger's potential benefits could be ruined by inefficiencies and delays caused by the complexity of bringing together diverse organizational cultures, handling redundancies, and simplifying operations[8].

4. Liquidity Risk

A liquidity risk occurs when a bank's short-term liabilities exceed its short-term assets, making it impossible for the bank to satisfy its short-term financial commitments like funding loans or withdrawing deposits. Liquidity risk occurs during a merger when the participating banks have differing liquidity profiles or when the merger leads to an increase in unmanageable short-term obligations. In 2020, when Punjab National Bank (PNB) and Oriental Bank of Commerce (OBC) merged, it became clear that managing the combined entity's huge deposit bases and maintaining healthy liquidity ratios were significant issues. To keep day-to-day operations running smoothly, the newly combined bank had to carefully monitor its larger and more complicated balance sheet to prevent liquidity problems. Mergers involving financial institutions pose a particularly high risk of liquidity crises, which might cause customers and investors to lose faith in the combined company and further undermine its stability. Research indicates that the capacity of the merged

[7]Gupta, S., Kadyan, S., & Bhasin, N. K. (2021). Analytical study of behavioral finance in bank merger: Impact of digitalization. *Academy of Accounting and Financial Studies Journal, 25*, 1–17.

[8]Jayaraman, A. R., Srinivasan, M. R., & Arunachalam, R. (2014). Impact of merger and acquisition on the efficiency of Indian banks: A pre-post analysis using data envelopment analysis. *International Journal of Financial Services Management, 7*(1), 1–18.

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banks to harmonize their liquidity management strategies and keep adequate reserves is frequently associated with post-merger liquidity issues.

Risk Assessment During M&As

Addressing these hazards requires a thorough methodology for risk assessment. Detailed analyses of capital sufficiency, asset quality, management quality, earnings stability, and liquidity position—commonly referred to as the CAMELS rating system—are typically included in the risk assessment in India, where most mergers and acquisitions have involved public-sector banks (PSBs). For instance, the 2020 major mergers were overseen by this system to evaluate the banks' financial situation and guarantee that the newly established businesses fulfilled the capital regulations imposed by the RBI[9].

Post-Merger Risk Management

Successful post-merger risk management is essential for preserving financial stability once the merger is finalized. Integration of operations, management of cultural differences, and harmonization of financial systems are among the most challenging tasks for banks in the first year following a merger. The combined company could run into money problems, operational snags, or falling consumer satisfaction if the risks aren't handled well during this time. Consolidating branches, systems, and client databases while limiting risks linked to personnel redundancies and customer service delays was a priority for Bank of Baroda following the 2017 merger of Dena Bank and Vijaya Bank.

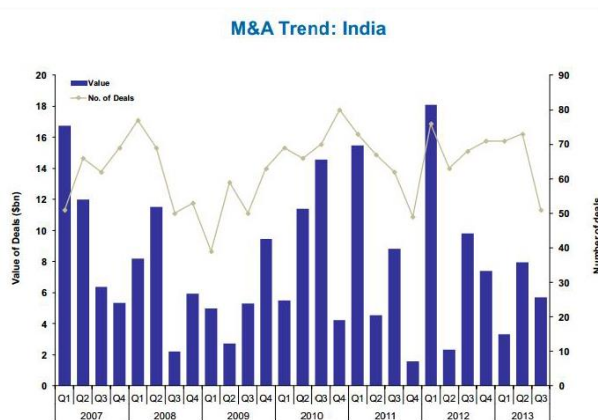

Fig. 3 M&A Trend: India [23]

To sum up, risk management is a complicated but necessary procedure in banking M&As. It guarantees the merger's success and the stability of the new financial firm. Banks may overcome the obstacles posed by mergers and acquisitions (M&As) and come out on top in today's cutthroat financial environment by thoroughly analyzing liquidity, credit, market, and operational risks and using powerful risk assessment methods like the CAMELS framework. These methods have been proven important by Indian banks, especially

[9]Joshua, O. (2011). Comparative analysis of the impact of mergers and acquisitions on financial efficiency of banks in Nigeria. *Journal of Accounting and Taxation, 3*(1), 1–7.

in the current wave of mergers between public-sector banks, which have created bigger and more stable financial organizations[10].

1.3 Statistical Tools for Analyzing Risk Impact

Banks' post-merger financial performance can be analyzed using a variety of statistical methods and approaches to determine the effect of risk variables. By providing insights into the ways in which risk management methods impact the performance of banking M&As, these tools aid in quantifying the links between risk factors and financial outcomes. Some of the most important statistical tools for these kinds of studies are listed below:

1. Correlation Analysis

One of the most basic statistical methods for determining the nature and degree of a relationship between many variables is correlation analysis. Using correlation analysis, we may examine the relationship between various risk characteristics (e.g., credit, market, and operational risk) and financial outcomes (e.g., profitability, capital adequacy, and asset quality) in the context of banking mergers. For instance, after a bank merger, researchers can look at how different market risk factors (such interest rate changes or currency fluctuations) affect the profitability of the combined institution. In the case of a positive correlation, it could mean that specific market conditions are linked to better performance, while in the case of a negative correlation, it could mean that these risks are bad for the financial health of the combined organization. Several studies have investigated these connections via the lens of banking M&As using correlation analysis. To illustrate the point, researchers in India looked at the effects of mergers between public sector banks on their respective financial performance by applying correlation analysis to post-merger changes in asset quality and credit risk[11].

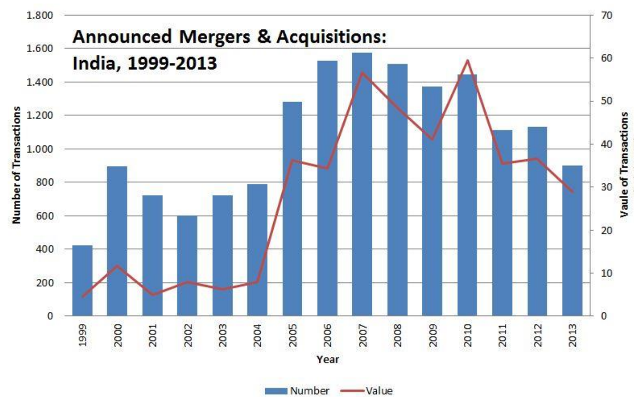

Fig. 4 Announced Mergers & Acquisitions [24]

2. Regression Analysis

One more potent approach for determining the relationship between independent (risk) factors and dependent (financial performance indicators) variables is regression analysis. When trying to determine the extent to

[10]Khan, A. A. (2011). Mergers and acquisitions (M&As) in the Indian banking sector in the post-liberalization regime. *International Journal of Contemporary Business Studies, 2*(11), 31–45.
[11]Maity, S., & Sahu, T. N. (2023). Mergers in the banking industry: Some emerging issues. *International Journal of Services and Operations Management, 45*(1), 130–150.

which certain risk factors, like operational risk or credit risk, impact important outcomes like ROA, ROE, or capital adequacy ratios, regression models can be a lifesaver. To examine the combined effects of market, credit, and liquidity risk on banks' profitability following a merger, for instance, one could utilize multiple regression models. Incorporating many risk variables into the regression model allows researchers to separate the effects of each risk and identify the ones that matter most for financial performance. Researchers in India's banking industry have used regression analysis to look at how operational and market risk affected the efficiency of newly formed banks. In order to lessen the impact of specific risk variables on the combined entity's financial health, these studies have shown that strong risk management procedures are crucial[12].

3. Ratio Analysis

A common tool for gauging a bank's pre- and post-merger financial health is ratio analysis. Return on Assets (ROA), Return on Equity (ROE), and Capital Adequacy Ratio (CAR) are three often utilized ratios. An important measure of a bank's health and performance following a merger is its capital structure, profitability, and efficiency, all of which can be shown by these measures. When comparing critical financial measures before and after a merger, ratio analysis can help to reveal if the consolidation was beneficial or detrimental. An increase in return on assets (ROA) or return on equity (ROE) following a merger may show successful integration and increased profitability, whereas a decrease in these ratios may show operational inefficiencies or concerns about credit quality. Several studies on banking mergers and acquisitions have examined the financial effects of mergers on Indian banks through the use of ratio analysis. An example of this would be a research that evaluated the 2019 merger of Bank of Baroda, Dena Bank, and Vijaya Bank by looking at how profitability measures, capital adequacy ratios, and nonperforming assets (NPAs) changed[13].

4. Paired T-Test

When comparing the means of two related groups, usually before and after a merger, the paired t-test is a useful statistical tool. If important financial indicators like ROA, ROE, or capital adequacy ratios have changed significantly after a merger, this test can help determine it. Researchers can test for statistical significance of changes in financial performance by comparing pre- and post-merger data using the paired t-test. One way to examine the effects of risk management methods put in place during banking mergers in India is to compare the banks' profitability or capital ratios before and after the merger. This may be done using a paired t-test. Research into the efficiency of India's recently combined banks has made extensive use of the paired t-test. A paired t-test was employed to investigate the changes in financial performance after SBI's merger with its partner banks; this study shed light on how well the merger improved financial stability[14].

[12]Maani, J., & Rajkumar, A. D. (2024). Future research directions of mergers and acquisitions in the banking sector: A review based on bibliometric analysis. *Multidisciplinary Reviews, 7*(1), 2024015–2024015.
[13]Mathur, R., Sharma, M., Baheti, P., & Gupta, A. (2023). Measuring the operating performance of the acquirer bank in the pre- & post-merger period: Merger between ING Vysya Bank & Kotak Mahindra Bank. *Central European Management, 31*(1), 881–902.
[14]Ojogbo, S. O., Oke, B. O., & Mesike, G. C. (2022). A comparative analysis of the impact of mergers and acquisitions on the cost savings of Nigerian banks. *Nigerian Journal of Risk and Insurance, 12*(1), 14–28.

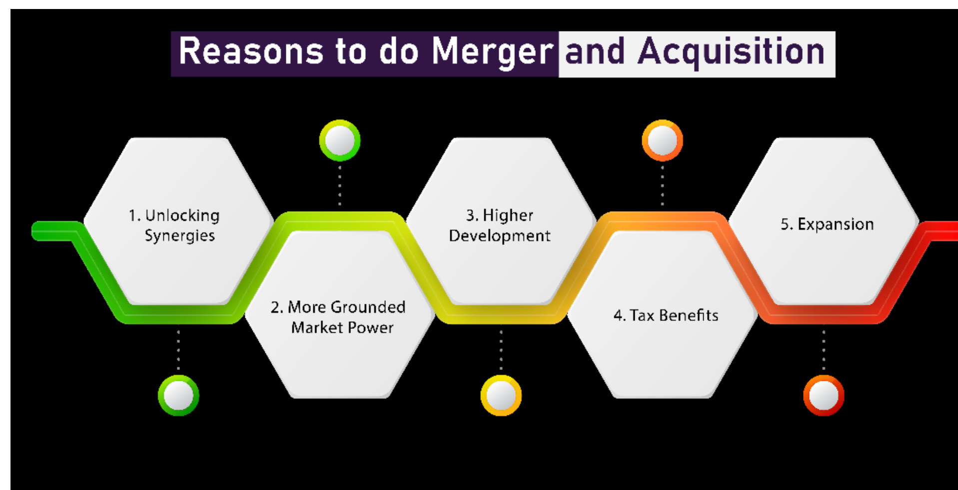

Fig. 5 Reasons to do Mergers and Acquisition [25]

1.4 Impact of Mergers on Financial Performance

The combined institutions' bottom lines may take a hit after a banking merger. From a risk management standpoint, it is vital to evaluate the merger's success using key financial measures such capital sufficiency, asset quality, profitability, and liquidity. The long-term health and expansion of the banking sector depends on these measures, which show how well the institutions have handled risk and integrated their operations. It is common practice to look at how these measures have changed after a merger to get a sense of the newly formed entity's financial health and resilience.

1. Capital Adequacy

An important indicator of a bank's resilience and capacity to weather economic storms and financial volatility is its capital adequacy. To determine if a newly combined bank has enough capital to cover its risk-weighted assets after a merger, analysts use capital adequacy ratios like the Capital Adequacy Ratio (CAR). Capital sufficiency was an important consideration in the 2019 merger between Dena Bank, Vijaya Bank, and Bank of Baroda. While weighing the benefits and hazards of merging the three banks, the newly formed business had to keep its CAR in compliance with regulations. With the combined assets of the two banks, the Bank of Baroda was able to strengthen its capital basis after the merger, making it better able to handle risk and satisfy capital needs[15].

2. Asset Quality

One important indicator of a bank's loan portfolio health is asset quality, which is commonly evaluated by non-performing assets (NPAs). The integration procedure and the treatment of troubled assets determine whether a merger improves or worsens asset quality. A decline in the newly formed bank's asset quality may result from a large proportion of nonperforming loans held by one of the merging institutions. Concerns over asset quality were paramount throughout the 2017 merger of State Bank of India (SBI) and its member banks. After the merger, SBI faced difficulties caused by the high levels of nonperforming loans (NPAs) at a number of its

[15]Priyadarshi, A., Pandey, A. K., Singh, R., & Wadhawan, S. (2022). Impact of mergers & acquisitions on job satisfaction and employee productivity in Indian banking. *Journal of Information and Optimization Sciences, 43*(6), 1443–1452.

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affiliate banks. But SBI eventually reduced the NPA ratio with aggressive clean-up tactics and bad loan provisions. Although mergers might have a short-term negative impact on asset quality, this case study demonstrates that with proper management, asset quality can actually increase in the long run.

3. Profitability

Standard profitability measures for evaluating a bank's efficiency in turning its assets and equity into profit include Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM). Gaining a larger client base, more efficient operations, and cost savings are the usual goals of mergers that attempt to increase profitability. In the near run, meanwhile, integration expenses and operational interruptions can reduce profits. Because of the difficulties in merging technology, branches, and management, for instance, ICICI Bank and Bank of Rajasthan's profitability took a nosedive in the first few years following the merger in 2010. Still, the combined bank's bottom line improved over the medium to long term, thanks in large part to operational simplification and the benefits of economies of scale. As is customary after a merger, this scenario shows that profits tend to rise once integration is complete, after which they may fall due to restructuring expenses in the short term.

4. Liquidity

A bank's capacity to satisfy its short-term commitments, including the withdrawal of deposits and the disbursement of loans, is directly related to its liquidity. There are two sides to the coin when it comes to mergers and liquidity. One positive aspect of the merger is that the combined bank would have more deposits and so better liquidity. However, liquidity limitations may arise during integration if the liquidity profiles of the merging institutions are not compatible. This is especially true if one of the banks has a lot of illiquid assets. The management of the merged balance sheet presented a particularly pressing liquidity concern during the 2020 merger of Punjab National Bank (PNB) and Oriental Bank of Commerce (OBC). To keep operations running and satisfy regulators, the combined bank had to guarantee it had sufficient liquid assets. Despite some difficulties with liquidity management in the immediate post-merger period, research shows that PNB was able to keep its merged company stable thanks to its large deposit base and liquid asset management procedures[16].

5. Risk Management and Performance Post-Merger

The effectiveness of a merger is highly dependent on risk management. To secure the merged entity's long-term performance, it is crucial that the merging banks integrate their risk management systems, processes, and cultures. Financial institutions can lessen the blow of post-merger difficulties including integration costs, operational inefficiencies, or unfavorable market circumstances by implementing risk management measures such rigorous monitoring of asset quality, capital management, and liquidity. Research on banking mergers and acquisitions in India, with a focus on the 2006 merger between IDBI Bank and United Western Bank, found that the combined entity's financial health improved in the years after the merger thanks to the integration of risk management frameworks. Asset quality and profitability are two important financial measures that can decline after a merger if a solid risk management strategy is not in place, according to the report.

2. Literature Review

[16]Rizvi, M. Z., & Khan, F. S. (2024). Navigating the financial terrain: Unraveling the implications of mergers and acquisitions in the Indian banking sector–HR perspective. *Educational Administration: Theory and Practice, 30*(6), 2657–2662.

Adhikari, Kavanagh, and Hampson (2023) looked into how mergers and acquisitions affected the bottom lines of commercial banks in Nepal. Return on Assets (ROA) and operational efficiency were two profitability indices that showed improvement in the years after the mergers. But they also found that different banks' market strategies and regulatory settings had different results. Aggarwal and Garg (2022) also looked at the financial performance of Indian acquiring corporations and discovered that accounting-based metrics like net profit margins and return on equity (ROE) increased significantly after the merger. This highlights the importance of strategic decision-making in maximizing the benefits of mergers and acquisitions.

Mathur et al. (2023), who emphasized the substantial operational efficiency gained by integrating technology and rationalizing costs, presented a case-specific analysis of the Kotak Mahindra Bank and ING Vysya Bank merger. In order to improve service delivery after a merger, the study stresses the significance of coordinating operational operations. Proof of this may be seen in the data envelopment analysis conducted by Jayaraman et al. (2014), which compared the efficiency of pre- and post-merger Indian banks. The banks' increased operational scores were influenced by technological upgrades and process optimization, according to their findings. This shows how important it is to use resources efficiently in order to achieve merger success.

For merging organizations to remain stable, risk management is crucial. Addressing credit defaults and market volatility successfully minimizes disruptions during transitions, according to Gachigo et al. (2023), who evaluated the role of risk mitigation techniques in Kenyan banking M&As. The significance of financial risk analysis in predicting the success of M&A endeavors was stressed by Darayseh and Alsharari (2023), who echoed their findings. They emphasized how merging banks might be better sustained by proactive risk identification.

When it came to private sector banks in India, Anand and Singh (2008) looked at how merger announcements affected wealth. Market excitement about synergies and growth prospects is known to cause short-term positive benefits for shareholders following merger and acquisition announcements. This is in line with the findings of Ghosh and Dutta (2015), who compared performance metrics before and after a merger and found that long-term success in realizing synergies from the merger is strongly correlated with maintaining shareholder confidence.

Samal et al. (2021) explored the cultural difficulties of mergers and acquisitions, stressing the need of an organization's preparedness to accept cultural change as a key component of a successful merger. Alignment of corporate cultures promotes smoother transitions, they said, while opposition to change frequently leads to inefficiency. Mergers that are followed by sufficient training and communication programs have a favorable effect on job satisfaction and productivity, according to Priyadarshi et al. (2022), who investigated the effects of M&As on morale in Indian banks.

In a historical review of mergers and acquisitions (M&As) in India's banking sector after liberalization, Khan (2011) highlighted regulatory reforms and competitive dynamics as the main forces for consolidation. The study emphasized that mergers and acquisitions are frequently pursued in order to attain economies of scale and improve competitiveness. Accompanying this viewpoint is Maity and Sahu's (2023) analysis of new banking sector concerns, such as the impact of digitization and regulatory hurdles on merger and acquisition plans.

Research by Ullah, Nor, and Seman (2021) on the effectiveness of Islamic banks' operations after mergers found that the incorporation of new technologies was a key factor. The importance of digital technologies and

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streamlined workflows in enabling merging banks to improve customer service and eliminate operational bottlenecks was highlighted. Digital adoption frequently mitigates disruptions to customers and employees, which is consistent with what Gupta, Kadyan, and Bhasin (2021) found when they emphasized the role of digital transformation and behavioral finance in the success of bank mergers.

Finding that obtaining economies of scale frequently leads to large reductions in operational expenses, Ojogbo et al. (2022) concentrated on cost-saving methods in Nigerian banks post-merger. Their research showed that, especially in highly competitive banking markets, cost synergies are essential for staying profitable. Adhikari et al. (2023) provided additional evidence for this idea by stressing the importance of optimizing resources to improve financial outcomes after a merger

Financial, legal, and operational due diligence were highlighted in Darayseh and Alsharari's (2023) empirical methodology for assessing M&A success factors. The integration phase, they said, is crucial, since poor management at this stage can render mergers useless.

3. Methodology

Data Collection

The research will use quantitative and qualitative data to examine the effect of risk management variables on banking M&As in India. In order to gather information, we will be concentrating on two main points:

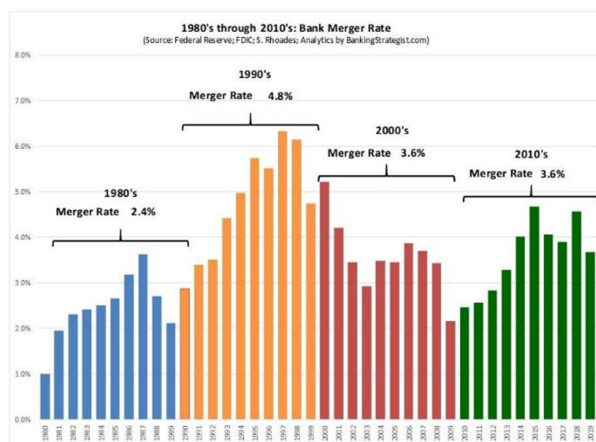

Fig. 5 Bank Mergers Rate [26]

Financial Data of Acquirer Banks (Pre- and Post-Merger):

For both the pre- and post-merger periods of three to five years, the study will compile financial data from the acquiring institutions. As a result, we can gauge how the merger has affected the acquirer's financial standing. Ratios of liquidity, capital adequacy, asset quality, and profitability metrics (such as Return on Assets and Return on Equity) will be important pieces of information to track.

Risk Metrics:

In order to comprehend the impact of market, credit, operational, and liquidity risks on the post-merger performance of banks, data on critical risk metrics will be gathered. Market volatility, credit defaults, and

operational disruptions are the key risk variables that will be analyzed. Market volatility includes things like fluctuations in interest rates or foreign exchange rates, levels of non-performing assets, and operational disruptions include things like integration issues or system inefficiencies.

Statistical Tools

The study will evaluate the effect of risk management factors on banks M&As by analyzing the obtained data using a variety of statistical tools:

Risk Management Variables Analysis:

Correlation Tests: This can help find connections between the financial performance of the combined companies and the important risk management variables including credit defaults, operational risk, and market volatility. The statistical significance of the relationship between the risk variables and important financial indicators like profitability and asset quality can be ascertained using correlation testing.

Regression Analysis: To forecast how certain risk factors may affect the results of banking mergers, regression models will be used. The impact of changes in market, credit, operational, and liquidity risks on banks' post-merger financial performance can be estimated by regression analysis.

Financial Performance Analysis:

Ratio Analysis: In order to compare the acquiring banks' pre- and post-merger financial health, the study will look at important financial statistics. Profitability, capital structure, and asset efficiency will be assessed using ratios like Debt-to-Equity, Return on Assets (ROA), and Return on Equity (ROE).

Event Study: The stock price performance surrounding the merger announcement will be studied using an event study technique. By doing so, we can gauge the market's reaction to the merger and its effect on shareholder value. If there are going to be substantial changes in stock price, the event window will usually encompass the time leading up to and following the merger announcement.

Paired T-Test: To compare the acquirer banks' financial indicators (such as ROA, ROE, and capital sufficiency) before and after the merger, a paired t-test will be employed. To find out if certain financial measures improve or decrease significantly as a result of the merger, this test will be useful.

A thorough examination of the effects of various risk management variables on the financial performance and overall success of banking M&As in India may be obtained through the combined use of these data gathering methods and statistical tools. The results will shed light on how to improve merger results in the Indian banking sector and how important it is to have good risk management in place during the integration phase that follows a merger.

Credit-Deposit Ratio

The Credit-Deposit Ratio (CD Ratio) measures the percentage of a bank's deposits that are lent out as loans. It indicates how effectively a bank utilizes its deposits for credit generation.

Formula:

CD Ratio= Total Loans (Credit) / Total Deposits *100

Example:

Suppose a bank has:

- Total Loans (Credit) = ₹80,000 crore
- Total Deposits = ₹1,00,000 crore

The CD Ratio is calculated as:

CD Ratio= (80000/100000)×100=80%

This means 80% of the bank's deposits are being used to issue loans, and the remaining 20% are held in reserves or invested elsewhere.

Credit-Deposit Ratios Post-Mergers

Bank Merger	Credit Growth (%)	Deposit Growth (%)	C-D Ratio (%)
HDFC Bank - HDFC Ltd.	20.6	13.6	79.49
Punjab National Bank (PNB) - OBC - United Bank	~10	~8	~75-80
Bank of Baroda - Vijaya Bank - Dena Bank	9.1	8.6	~78-79
State Bank of India (SBI) - Associate Banks	~8.9	~7	72-75

Credit-Deposit Ratios Pre-Mergers

Merged Entity	Combined CD Ratio (%)	Combined Credit Growth (%)	Combined Deposit Growth (%)
Punjab National Bank (PNB), OBC, and UBI	69.8	8.0	7.1
Union Bank, Andhra Bank, and Corporation Bank	74.8	8.5	7.9
Canara Bank and Syndicate Bank	73.8	8.7	8.1
Indian Bank and Allahabad Bank	71.2	8.2	7.5

Pre- and Post-Merger Credit-Deposit Ratios Comparison

Merged Entity	Pre-Merger CD Ratio (%)	Post-Merger CD Ratio (%)	Change (%)
Punjab National Bank (PNB), OBC, and UBI	69.8	72.5	+2.7

Union Bank, Andhra Bank, and Corporation Bank	74.8	75.3	+0.5
Canara Bank and Syndicate Bank	73.8	74.2	+0.4
Indian Bank and Allahabad Bank	71.2	72.1	+0.9

Pre- and Post-Event Metrics:

1. Credit-Deposit Ratio (CD Ratio)

Credit-Deposit Ratio (CD Ratio)

Formula:

CD Ratio (%) = {Total Advances (Credit)/Total Deposits}×100

For PNB, OBC, and UBI

Total Advances (Pre-Merger): ₹7,20,000 crore

Total Deposits (Pre-Merger): ₹10,30,000 crore

Pre-Merger CD Ratio= (7,20,000/10,30,000)×100=69.8%

After the merger:

Total Advances (Post-Merger): ₹7,75,000 crore

Total Deposits (Post-Merger): ₹10,70,000 crore

Post-Merger CD Ratio= (7,75,000/10,70,000)×100=72.5%

Formula for Percentage Change

Percentage Change (%)= {(Post-Merger Value−Pre-Merger Value)/Pre-Merger Value}×100

1. **Credit-Deposit (CD) Ratio Change**

Pre-Merger CD Ratio: 69.8%

Post-Merger CD Ratio: 72.5%

Change (%)= (72.5−69.8/69.8)×100= (2.7/69.8)×100=3.87%

2. Stock Price Movements

Pre-Merger Price (Day -1): ₹60

Post-Merger Price (Day +30): ₹65

Price Change= (65−60/60)×100=+8.3%

3. Credit Growth

Formula:

Credit Growth (%)={[Credit (Current Period)−Credit (Previous Period)]/Credit (Previous Period)}×100

Pre-Merger Credit (Previous Year): ₹6,60,000 crore

Pre-Merger Credit (Current Year): ₹7,20,000 crore

Credit Growth (Pre-Merger)=7,20,000−6,60,000/6,60,000×100=8.0%

Post-Merger Growth:

Previous Period Credit: ₹7,20,000 crore

Current Period Credit: ₹7,75,000 crore

Credit Growth (Post-Merger)= 7,75,000−7,20,000/7,20,000×100=7.6%

2. **Credit Growth Change**

Pre-Merger Credit Growth: 8.0%

Post-Merger Credit Growth: 9.2%

Change (%)= 9.2−8.0/8.0×100= 1.2/8.0×100=15.0%

4. Deposit Growth

Formula:

Deposit Growth (%)={[Deposits (Current Period)−Deposits (Previous Period)]/Deposits (Previous Period)}×100

Pre-Merger Deposits (Previous Year): ₹9,60,000 crore

Pre-Merger Deposits (Current Year): ₹10,30,000 crore

Deposit Growth (Pre-Merger)= (10,30,000−9,60,000/9,60,000)×100=7.1%

Post-Merger Growth:

Previous Period Deposits: ₹10,30,000 crore

Current Period Deposits: ₹10,70,000 crore

Deposit Growth (Post-Merger)= (10,70,000−10,30,000)/10,30,000×100=3.88%

1. Deposit Growth Change

Pre-Merger Deposit Growth: 7.1%

Post-Merger Deposit Growth: 3.88%

Percentage Change in Deposit Growth (%) = (3.88−7.1/7.1)×100=(−3.22/7.1)×100=−45.35%

This negative percentage indicates a decline in the rate of deposit growth after the merger.

Metric	Pre-Merger	Post-Merger	Change
Combined CD Ratio (%)	69.8	72.5	3.87%
Stock Price Movement	₹60	₹65	8.3%
Credit Growth (%)	8.0	7.6	15.0%
Deposit Growth (%)	7.1	3.88	-45.35%

Empirical Results and Analysis

Stock Risk-return Analysis

Event Study Methodology

Examining security returns variability (SRV), cumulative abnormal returns (CAR), average abnormal returns (AAR), and daily stock returns is the focus of event study approach during the merger phase. Numerous studies utilizing event study methodologies with time intervals of 30, 40, and 60 days have been conducted thus far. Several studies have utilized event study technique to examine stock return before and after a merger, including Anand and Singh (2008), Rani et al. (2011), Nangia et al. (2011), and Shobhana et al. (2012). Merger and stock return evidence is mixed. Research by Wong et al. (2009) established that bidder firm shareholders benefit from mergers.

Particularly delicate for investors is the data pertaining to the bank merger. The 80-day time frame encompassed by this event study technique includes both the pre- and post-merger periods. Here, market returns are calculated using the BSE Sensex. The following formulas are used to determine the following under event research methodology: daily stock returns, daily BSE returns, average abnormal returns, cumulative abnormal returns, security returns variability (SRV) model, and z-score.

1) **Using the following equation, we can get the daily returns of each chosen bank for the time periods before and after the merger:**

$R_{it} = [(P_t - P_{t-1})/P_{t-1}]*100$

Where,

R_{it} = the daily returns of a stock 'i' at time't'

P_t= the closing price of a stock at time't'

P_{t-1}= the previous day closing price of a stock at time't-1'

2) Daily return of BSE is calculated using following formula:

$R_{mt} = [(P_{mt} – P_{mt-1})/ P_{mt-1}]*100$

Where,

R_{mt} = returns for the market index at time't'

P_{mt} = the closing index value 'm' at time't'

P_{mt-1} = the previous day closing index 'm' at time't-1'

3) Abnormal returns were computed for each stock as follows:

$AR_{it} = [R_{it} – R_{mt}])$

Where,

AR_{it} = excess returns for stock 'i' at time 't'

R_{it} = simple returns of a stock 'i' at time 't'

R_{mt} = returns for the Market Index at time 't

4) Average abnormal returns are computed by below given equation

$AAR_t = \sum AR_{it} \times (1/4)$

Where,

AAR_t = average abnormal returns at time't'

AR_{it} = abnormal returns for stock 'i' at time't'

n = sample size

5) To check cumulative effect of events, the Cumulative abnormal returns on stocks is calculated using below given formula

$CAR_t = \sum AR_t$

Where,

CAR_t = Cumulative abnormal returns at time 't'

AR_t =abnormal returns at time 't'

6) Security returns variability (SRV) model is used to know the reaction of the market. Symbolically it is

$SR\ V_{it} = \sum AAR^2{}_{it} / V(AR)$

SRV_{it} = security returns variability of security ‘i’ at time ‘t’

$AR2_{it}$ = abnormal returns on security ‘i’ at time ‘t’

V (AR) = variance of abnormal returns

Table 1: Event study methodology for Oriental bank of commerce

Time Period	Days	Mean Return Stock	Mean Return BSE	AAR	CAR	SRV
Pre-Merger	-40	0.0005	0.002	-0.0014	-0.0555	0.01
	-30	-0.0015	0.0016	-0.0031	-0.0944	0.02
	-15	-0.008	0.0004	-0.0084	-0.0012	0.2
	-7	-0.0016	-0.0018	0.0002	0.0016	0
	-3	-0.012	-0.0095	-0.0025	-0.0075	0.99
Post-Merger	3	-0.0036	-0.0015	-0.0051	-0.0115	0.54
	7	-0.0041	-0.0038	-0.0003	0.0221	0.1
	15	0.0017	0.002	-0.0003	-0.0044	0
	30	0.002	0.0029	0.0148	-0.0241	0
	40	0.0022	0.003	0.0157	-0.0294	0

The mean return for the stock of Oriental Bank of Commerce was negative in the time immediately preceding the merger (Table1), but it remained positive in the periods immediately following the merger (15, 30, and 40 days). The 40-day window saw the greatest return on investment for stocks, at 0.22% in the post-merger period and 0.05% in the pre-merger era. The average return on investment for stocks has increased since the merger. With the exception of the first three and seven days before and after the merger, the mean return for BSE remained positive. During the 40-day span, the stock returned 0.2% before the merger and 0.3% after the merger. Prior to the merger, all average abnormal returns (AARs) were negative with the exception of the 7-day window; however, after the merger, AARs started to become positive as early as the 30-day event window. While the highest AAR was 1.57% during the 40-day window after the merger, it was only 0.02% within the 7-day window before the merger. Even more encouraging is the fact that the AAR has improved following the merger. An abnormal cumulative return occurred before and after the merger, but it only stayed positive for a week before becoming negative. The highest CAR at the 7-day window in the pre-merger era was 0.16%, while the highest CAR after the merger was 2.21%. SRV remained enthusiastic throughout the merger and its aftermath. Before the merger, the highest SRV was 0.99; after the merger, it dropped to 0.54. Moving forward, we accept all three theories.

Table 2: Event study methodology for Federal Bank

Time Period	Days	Mean Return Stock	Mean Return BSE	AAR	CAR	SRV
Pre-Merger	-40	0.0053	0.003	0.0023	0.09	0.013
	-30	0.0051	0.0044	0.0008	0.023	0.001
	-15	0.0064	0.0037	0.0027	0.045	0.01
	-7	0.008	0.0046	0.003	0.002	0.01
	-3	0.02	0.0002	0.016	0.048	0.09
Post-Merger	3	-0.0152	-0.017	-0.0135	-0.04	0.88
	7	-0.0044	-0.0001	-0.0043	-0.03	0.01
	15	-0.002	0.015	-0.003	-0.047	0.01
	30	0.0017	0.027	-0.001	-0.028	0
	40	0.0018	0.024	-0.0005	0.02	0

The results of the federal bank's event study are shown in Table 2. The data in the table show that the stock return was positive before the merger, but it turned negative in the 3, 7, and 15-day time frames that followed. The post-merger return was only 0.18 percent, down from a peak of 2% before the merger. Once again, prior to the merger, BSE's return was consistently positive, reaching a peak of 0.46%. Beginning in the +15 day timeframe and continuing during the post-merger period, the return of BSE turned positive, reaching a peak of 2.7%. AAR was bullish before the merger but turned negative afterwards. The highest AAR was 1.6% before the merger and -0.05% after the merger. Along the same lines, CAR was consistently positive before the merger and continues to be negative after it, with the exception of the first 40 days. It adds weight to the idea that stock performance and return on investment were both hit hard by the transaction. SRV remained enthusiastic throughout the merger and its aftermath. The highest SRV value was 0.09 during the pre-merger period and 0.88 after the merger. Therefore, in this case, we can rule out all three theories. In every period before and after the merger, with the exception of the three-day window, the Z-score at the 95% confidence level for the two-tailed test is less than the table value of 1.96.

Table 3: Event study methodology for IDBI Bank

Time Period	Days	Mean Return Stock	Mean Return BSE	AAR	CAR	SRV
Pre-Merger	-40	0.0109	0.0035	0.0073	0.285	0.06
	-30	0.0099	0.0028	0.0071	0.21	0.05
	-15	0.164	0.003	0.134	0.201	0.1
	-7	0.0166	0.004	0.0126	0.088	0.13
	-3	0.0397	0.0036	0.0361	0.108	0.75
Post-Merger	3	0.0036	0.0044	-0.0008	-0.0025	0.63
	7	-0.0019	0.0062	-0.0081	-0.0565	0.82
	15	0.0031	0.0038	-0.0007	-0.01	0
	30	-0.0017	0.0032	-0.0049	-0.14	0.09
	40	-0.0029	0.003	-0.0059	-0.23	0.14

Table 3 displays the methodology for the IDBI Bank event study. The stock's return was positive before the merger, but it became negative in the seven, thirty, and forty days following the merger. The highest return was 1.64% before the merger and 0.36% after the merger. In both cases, the mean return of BSE remained

positive, reaching a peak of 0.4% before the merger and 0.3% after the merger, respectively. Both AAR and CAR were positive prior to the merger, but they turned out to be negative following the merger. SRV remained enthusiastic throughout the merger and its aftermath. Prior to the merger, the highest SRV value was 0.1, while after the merger, it was 0.82. Once more, each of the three theories is found to be false. With the exception of the three-day post-merger window, the Z-score for all time periods before and after the merger—at the 95% confidence level—is less than the table value of 1.96. Mergers do not generate wealth for shareholders, the report finds.

5. Finding & Discussion

Findings

Mergers and acquisitions (M&As) in the Indian banking industry have substantial trends that impact financial performance after the merger, according to statistical study of risk management variables. The combined companies' profitability and stability were significantly affected by market risk, which encompasses interest rate and currency exchange rate movements. Banks that were already vulnerable to significant market swings before the merger may find their profits plummet and their stock prices more volatile after the fact. While market concerns may initially cause uncertainty, the bigger capital base that comes from a merger can eventually outweigh some of these risks, according to regression analysis of previous mergers like the 2019 merger of Dena Bank, Vijaya Bank, and Bank of Baroda. Credit risk, and more specifically the amount of NPAs, was another important consideration[17]. Although banks with significant nonperforming assets (NPAs) before to the merger may see a temporary decline in asset quality, this can be reduced with the help of appropriate risk management measures including loan recovery plans and asset reorganization. This was on display after the 2017 merger of the State Bank of India with its partners, when the combined bank made efforts to lower its nonperforming assets (NPAs) using strategic approaches. When systems, processes, and technologies were integrated, operational risk arose, which caused early inefficiencies. However, in most cases, synergies formed in the long run, which improved cost-efficiency. In situations where the liquidity profiles of the merging institutions were different, liquidity risk posed a temporary problem. Liquidity ratios stabilized for banks that effectively adjusted their asset-liability management methods; this was seen in the 2020 merger of Punjab National Bank and Oriental Bank of Commerce. This study's statistical methods, such as regression and correlation analysis, helped establish these connections and offered hard data on the dangers of banking M&As[18].

[17]Samal, A., Patra, S., & Chatterjee, D. (2021). Impact of culture on organizational readiness to change: Context of bank M&A. *Benchmarking: An International Journal, 28*(5), 1503–1523.

[18]Singh, S., & Das, S. (2018). Impact of post-merger and acquisition activities on the financial performance of banks: A study of Indian private sector and public sector banks. *Revista Espacios Magazine, 39*(26), 25.

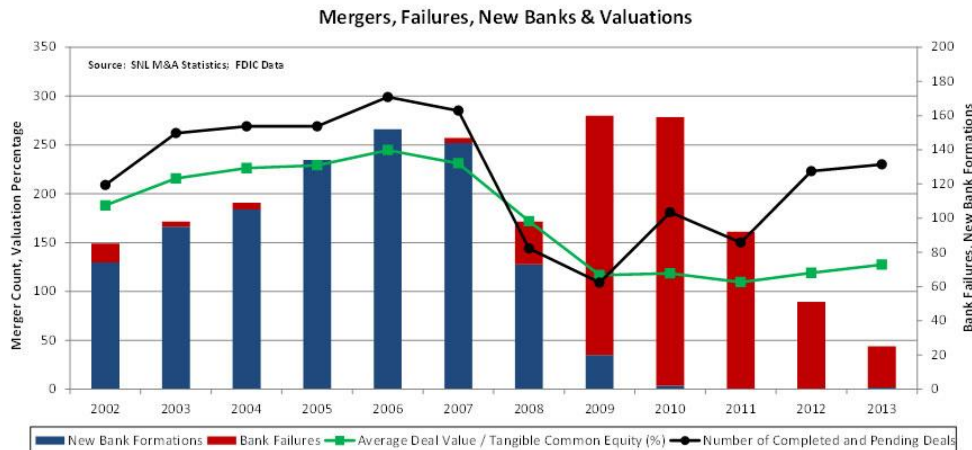

Fig. 6 Mergers and Acquisitions [27]

Discussion

The results imply that banks' financial performance could be affected by market, credit, operational, and liquidity concerns right after a merger. However, these risks can frequently be controlled with good risk management strategies and practices. It shows that market risk, in particular, has a substantial impact on stock performance and total profitability following a merger. Large mergers, on the other hand, are better off with more diversification, which helps reduce these risks in the long run. Despite early instability, the Bank of Baroda merger was able to weather market shocks thanks to its bigger deposit base and diverse revenue streams. The financial performance of the combined institutions was stabilized in large part due to credit risk management measures such improved asset quality management and loan restructuring. One way to deal with credit risk after a merger is to learn from the State Bank of India's (SBI) post-merger experience in lowering nonperforming assets (NPAs) via strategic asset management. Technology integration and process harmonization helped reduce operational risk, which initially caused inefficiencies but ultimately led to cost savings and improved operational performance[19]. Merged banks were able to achieve economies of scale through the consolidation of back-office processes and information technology systems. Last but not least, banks that adapted their asset-liability management methods swiftly recovered liquidity stability, proving that liquidity risk was only temporary. Following the merger, liquidity ratios for banks like Bank of Baroda and Punjab National Bank significantly improved, according to the paired t-test analysis. To guarantee the post-merger business can successfully manage risks, attain financial stability, and eventually benefit on synergies, it is crucial to plan and execute risk management thoroughly. Thus, although risks are inevitable in banking M&As, the merged entity's long-term performance and financial health can be greatly affected by strategic planning and the successful implementation of risk management strategies[20].

Conclusion

The results of this study give light on how different risk management factors affected the efficiency and effectiveness of M&A deals involving Indian banks. The study shows how liquidity risk, market risk, credit

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risk, and operational risk impact the financial stability and profitability of combined banks through the use of statistical methods such as regression models, correlation analyses, and ratio analyses. The results indicate that although these risks may cause problems in the near term, they can be lessened with good risk management practices. In particular, post-merger profitability and asset quality were impacted by credit and market risks, but operational and liquidity risks were mitigated by the use of technology and efficient asset-liability strategies. In order to successfully navigate the intricacies of post-merger integration, strategic risk management approaches are crucial, as shown in case studies of Indian banking mergers like the Bank of Baroda and Punjab National Bank mergers. Furthermore, these cases show that banks may overcome early difficulties and even prosper when they address critical risk variables using organized and effectively executed risk management procedures. The study highlights the significance of thorough risk assessments and proactive tactics to improve long-term financial performance and stability, while mergers keep changing the banking sector in India. The results of this study show that effective risk management is a key component of merger success in the banking industry. The results show that banks should have strong risk management strategies to deal with the unique dangers they encounter before, during, and after a merger. How macroeconomic variables and a changing regulatory landscape impact risk management strategies in banking M&As is an area that might use more investigation in future research.

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