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Comparative analysis of public and private banks in India: Performance Evaluation Using Statistical Techniques (2012-2022)

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Abstract
This study conducts a comprehensive comparative analysis of the performance of public and private sector banks in India over a decade (2012-2022). Utilizing data from the Reserve Bank of India, the research employs various statistical techniques including ratio analysis, CAMEL framework parameters, Data Envelopment Analysis (DEA), and hypothesis testing to evaluate operational efficiency, profitability, asset quality, and overall financial health. The findings reveal significant differences in performance metrics between public and private sector banks, with private banks generally demonstrating superior profitability ratios, asset quality, and operational efficiency. However, public sector banks show strengths in areas of financial inclusion and stability metrics. The paper concludes with policy implications and recommendations for improving banking sector performance in the Indian context.

Keywords: Banking performance, public sector banks, private sector banks, camel framework, data envelopment analysis, financial ratios, reserve bank of India

Introduction

The banking sector forms the backbone of India's financial system, playing a crucial role in economic development through capital formation, financial intermediation, and implementation of monetary policy. India's dual banking structure, comprised of public sector banks (PSBs) and private sector banks, presents a unique research opportunity to analyze operational differences, efficiency parameters, and performance metrics between these ownership models.

The period from 2012 to 2022 has been particularly eventful for the Indian banking sector, characterized by significant regulatory changes, the implementation of the Insolvency and Bankruptcy Code, asset quality recognition norms, bank recapitalization programs, and the COVID-19 pandemic's impact. These events have tested the resilience and adaptability of both public and private sector banks, making this timeframe especially relevant for comparative analysis.

This research aims to

1. Compare and contrast the financial performance of public and private sector banks in India over the decade 2012-2022
2. Evaluate operational efficiency using statistical techniques including ratio analysis and Data Envelopment Analysis
3. Assess asset quality and non-performing asset (NPA) management capabilities
4. Analyze profitability parameters across ownership structures
5. Examine capital adequacy and risk management practices
6. Provide policy recommendations based on empirical findings

The study's significance lies in its comprehensive statistical approach, utilizing the latest available data from the Reserve Bank of India to inform policy decisions, banking regulation, and potential reforms in corporate governance and operational strategies across India's banking sector.

Literature Review

1. Theoretical Framework

Banking performance measurement has evolved substantially over decades, with theoretical frameworks focusing increasingly on multi-dimensional approaches rather than singular profit metrics. The literature broadly categorizes bank performance into:

1. Operational efficiency and productivity measures (Das *et al*., 2015; Kumar & Gulati, 2018) [10, 20]
2. Profitability and financial performance (Sharma & Mani, 2012; Sahoo & Mishra, 2016) [32, 34]
3. Asset quality and risk management (Uppal, 2017; Kundu & Banerjee, 2019) [4, 21, 42]
4. Financial inclusion and social contribution (Chakrabarty, 2013; Sarma & Pais, 2016) [8, 33]

The ownership structure's impact on these parameters has been extensively debated, with agency theory, public choice theory, and property rights theory providing competing explanations for performance differentials.

2. Empirical Studies

Several empirical studies have compared the performance of public and private sector banks in India, though results have been mixed. Mohan and Ray (2019) [23] found that private banks outperformed public banks in profitability and operational efficiency during 2010-2018. Conversely, Kumar (2017) argued that public banks demonstrated greater stability during economic downturns and better served financial inclusion objectives.

In the context of asset quality, Mishra and Pradhan (2020) [22] documented increasing divergence between public and private banks after 2015, attributing this primarily to the Asset Quality Review initiated by RBI. Singh and Das (2018) [35, 36] employed DEA to conclude that technical efficiency scores were significantly higher for private banks between 2008-2017.

Kumar and Gulati (2020) [19] found significant differences in NPA management, noting private banks' superior provisioning coverage ratios and recovery rates. However, Chakraborty (2016) disputed this, arguing that sectoral exposure rather than ownership drove NPA accumulation patterns.

3. Research Gaps

Despite extensive literature, several gaps remain:

1. Most studies utilize data that predates significant disruptions such as demonetization (2016) and the COVID-19 pandemic
2. Statistical techniques have often been employed in isolation rather than complementary frameworks
3. Limited attention to the impact of regulatory changes on comparative performance
4. Insufficient focus on technology adoption and digital banking parameters
5. Few studies control for bank size and market concentration when comparing ownership structures

This study aims to address these gaps by utilizing recent data (through 2022) and employing multiple statistical techniques to provide a comprehensive comparative analysis.

Research Methodology

1. Data Sources

This study utilizes secondary data primarily from the following sources:

- Statistical Tables Relating to Banks in India (Reserve Bank of India, 2012-2022) [29]
- Report on Trend and Progress of Banking in India (RBI, 2012-2022)
- Financial Stability Reports (RBI, 2012-2022)
- Annual Reports of individual banks (2012-2022)
- Database on Indian Economy (RBI, 2012-2022)

2. Sample Selection

The study analyzes all scheduled commercial banks in India categorized into:

- **Public Sector Banks:** All nationalized banks including State Bank of India and its associates (before merger), and other nationalized banks (sample size varies from 27 in 2012 to 12 in 2022 due to consolidation)
- **Private Sector Banks:** All private sector banks including old and new private sector banks (sample size varies from 22 in 2012 to 21 in 2022)

Foreign banks are excluded from the study to maintain focus on domestic ownership structures.

3. Statistical Techniques Employed

3.1 Ratio Analysis

The following key financial ratios are computed and analyzed:

Profitability Ratios

- Return on Assets (ROA)
- Return on Equity (ROE)
- Net Interest Margin (NIM)
- Cost-to-Income Ratio

Asset Quality Ratios

- Gross NPA Ratio
- Net NPA Ratio
- Provision Coverage Ratio
- Slippage Ratio

Capital Adequacy Ratios

- Capital Adequacy Ratio (CAR)
- Tier-1 Capital Ratio
- Risk-Weighted Assets to Total Assets

Efficiency Ratios

- Business per Employee
- Profit per Employee

- Return on Business

3.2 CAMEL Framework Analysis

The CAMEL framework components are analyzed:

- **C**apital Adequacy
- **A**sset Quality
- **M**anagement Efficiency
- **E**arnings Quality
- **L**iquidity

3.3 Data Envelopment Analysis (DEA)

DEA is employed to measure technical efficiency, pure technical efficiency, and scale efficiency. Input variables include operating expenses, deposits, and fixed assets, while output variables include advances, investments, and non-interest income.

3.4 Hypothesis Testing

The following statistical tests are performed:

- Independent samples t-test for comparing means of performance indicators
- Mann-Whitney U test for non-parametric comparisons
- ANOVA for time-series variations
- Panel data regression to control for bank-specific and time-specific effects

4. Model Specification

For regression analysis, the following model is specified:

$$\text{Performance\_it} = \alpha + \beta_1(\text{Ownership\_i}) + \beta_2(\text{Bank Characteristics\_it}) + \beta_3(\text{Macroeconomic Variables\_t}) + \varepsilon\_it$$

Where:

- Performance_it represents various performance metrics for bank i at time t
- Ownership_i is a dummy variable (1 for private banks, 0 for public banks)
- Bank Characteristics include size, age, branches, and business model factors
- Macroeconomic Variables include GDP growth rate, inflation, and policy interest rates

Results and Analysis

1. Trend Analysis of Key Performance Indicators (2012-2022)

1.1 Profitability Metrics

Return on Assets (ROA)

Analysis of ROA trends reveals a significant divergence between public and private sector banks, particularly after 2015. While private banks maintained relatively stable ROA in the range of 1.1% to 1.5% throughout the decade, public sector banks experienced a sharp decline from 0.78% in FY2013 to -0.65% in FY2018, before a gradual recovery to 0.45% by FY2022.

The statistical analysis shows:

- Private Banks: Mean ROA = 1.27%, $\sigma = 0.21\%$
- Public Banks: Mean ROA = 0.15%, $\sigma = 0.58\%$
- t-statistic = 7.83, $p < 0.01$ (indicating statistically significant difference)

Return on Equity (ROE)

ROE figures demonstrate even wider disparity:

- Private Banks: Mean ROE = 14.2%, $\sigma = 2.8\%$
- Public Banks: Mean ROE = 2.7%, $\sigma = 7.4\%$
- t-statistic = 6.92, $p < 0.01$

The temporal analysis shows that public sector banks' ROE remained negative during FY2016-FY2019, while private banks maintained double-digit ROE throughout most of the period, with minor dips during the pandemic years.

Net Interest Margin (NIM)

NIM showed less dramatic but still significant differences:

- Private Banks: Mean NIM = 3.45%, $\sigma = 0.31\%$
- Public Banks: Mean NIM = 2.42%, $\sigma = 0.19\%$
- t-statistic = 11.24, $p < 0.01$

1.2 Asset Quality Parameters

Gross NPA Ratio

Asset quality deterioration affected both bank categories but with varying severity:

- Private Banks: Mean GNPA = 3.91%, $\sigma = 1.64\%$
- Public Banks: Mean GNPA = 10.87%, $\sigma = 4.32\%$

- t-statistic = 6.21, $p < 0.01$

The trend analysis reveals that GNPA ratios peaked in FY2018 for public sector banks at 14.6%, compared to 4.8% for private sector banks. By FY2022, these had moderated to 7.8% and 3.7% respectively.

Provision Coverage Ratio (PCR)

Private banks maintained consistently higher PCR:

- Private Banks: Mean PCR = 68.4%, $\sigma = 5.7\%$
- Public Banks: Mean PCR = 54.2%, $\sigma = 9.3\%$
- t-statistic = 5.84, $p < 0.01$

1.3 Efficiency Parameters

Cost-to-Income Ratio

Operational efficiency measured through cost-to-income ratio showed:

- Private Banks: Mean C/I = 45.6%, $\sigma = 3.8\%$
- Public Banks: Mean C/I = 53.4%, $\sigma = 5.7\%$
- t-statistic = 4.91, $p < 0.01$

Business per Employee

Business per employee (in million rupees) revealed:

- Private Banks: Mean BPE = ₹187.2M, σ = ₹38.4M
- Public Banks: Mean BPE = ₹142.6M, σ = ₹31.7M
- t-statistic = 3.89, $p < 0.01$

2. CAMEL Framework Analysis

2.1 Capital Adequacy

Both bank categories maintained capital adequacy ratios above regulatory requirements, though private banks showed higher buffers:

- Private Banks: Mean CAR = 16.79%, $\sigma = 1.34\%$
- Public Banks: Mean CAR = 12.45%, $\sigma = 1.05\%$
- t-statistic = 10.21, $p < 0.01$

The gap widened particularly after FY2017, coinciding with increased capital requirements under Basel III and the needs for NPA provisioning.

2.2 Asset Quality

Beyond GNPA and NNPA ratios, asset quality analysis revealed significant differences in credit risk management:

- Fresh slippage ratio averaged 3.45% for PSBs vs. 1.87% for private banks ($t = 4.79$, $p < 0.01$)
- Restructured standard advances to total advances ratio was 2.76% for PSBs vs. 1.34% for private banks ($t = 3.64$, $p < 0.01$)

2.3 Management Efficiency

Management efficiency parameters showed mixed results:

- Private banks outperformed in profit per employee ($t = 6.73$, $p < 0.01$)
- Business growth rates were comparable with no statistically significant difference ($t = 1.23$, $p = 0.226$)
- PSBs showed better branch expansion in underbanked areas ($t = 2.87$, $p < 0.05$)

2.4 Earnings Quality

Earnings quality analysis showed:

- Private banks had higher non-interest income to total income ratio ($t = 3.41$, $p < 0.01$)
- Fee income growth was significantly higher for private banks ($t = 4.13$, $p < 0.01$)
- Earnings volatility was lower for private banks ($F = 2.67$, $p < 0.05$)

2.5 Liquidity

Liquidity parameters showed fewer significant differences:

- Credit-deposit ratio: No significant difference ($t = 1.14$, $p = 0.259$)
- Liquid assets to total assets: Private banks maintained slightly higher ratios ($t = 2.31$, $p < 0.05$)
- LCR compliance: Both categories maintained above-required levels with no significant difference

3. Data Envelopment Analysis (DEA) Results

The DEA analysis yielded important insights into technical efficiency:

Technical Efficiency Scores (CRS assumption)

- Private Banks: Mean TE = 0.886, $\sigma = 0.079$
- Public Banks: Mean TE = 0.741, $\sigma = 0.112$
- Mann-Whitney $U = 124$, $p < 0.01$

Pure Technical Efficiency (VRS assumption)
- Private Banks: Mean PTE = 0.923, σ = 0.058
- Public Banks: Mean PTE = 0.809, σ = 0.097
- Mann-Whitney U = 147, $p < 0.01$

Scale Efficiency
- Private Banks: Mean SE = 0.960, σ = 0.034
- Public Banks: Mean SE = 0.914, σ = 0.065
- Mann-Whitney U = 198, $p < 0.05$

The results indicate that private banks operate closer to the efficient frontier in both technical and scale efficiency. Year-wise analysis shows that the efficiency gap widened after 2015, coinciding with the Asset Quality Review implementation.

4. Panel Data Regression Results

The panel data regression controlling for bank-specific characteristics and macroeconomic factors yielded the following results:

Dependent Variable: ROA
- Ownership Dummy (Private=1): Coefficient = 0.723, $p < 0.01$
- Log(Assets): Coefficient = 0.145, $p < 0.05$
- Branch Network Density: Coefficient = -0.042, $p = 0.127$
- GDP Growth Rate: Coefficient = 0.089, $p < 0.01$
- $R^2 = 0.634$, $F = 21.73$, $p < 0.01$

Dependent Variable: GNPA Ratio
- Ownership Dummy (Private=1): Coefficient = -4.367, $p < 0.01$
- Log (Assets): Coefficient = 0.983, $p < 0.01$
- Priority Sector Lending Ratio: Coefficient = 0.142, $p < 0.05$
- GDP Growth Rate: Coefficient = -0.752, $p < 0.01$
- $R^2 = 0.712$, $F = 27.45$, $p < 0.01$

These results confirm that ownership structure remains a significant determinant of performance even after controlling for size, business model, and macroeconomic conditions.

5. Impact of Key Events and Policy Changes

Three significant events showed varying impacts on bank categories:

Asset Quality Review (2015-16)
- PSBs experienced 287 bps increase in GNPA ratio within two quarters
- Private banks saw 124 bps increase
- Difference-in-difference analysis: $t = 4.21$, $p < 0.01$

Demonetization (2016-17)
- CASA deposit growth: PSBs +7.42% vs Private banks +5.17% ($t = 2.34$, $p < 0.05$)
- Fee income impact: PSBs -4.21% vs Private -1.73% ($t = 2.87$, $p < 0.05$)

COVID-19 Pandemic (2020-21)
- Loan growth: PSBs +3.6% vs Private +9.3% ($t = 4.67$, $p < 0.01$)
- Restructured advances: PSBs +3.4% vs Private +1.8% ($t = 3.12$, $p < 0.01$)

Discussion of Findings

1. Profitability Differences

The substantial profitability gap between public and private sector banks can be attributed to several factors:

1. **Higher operational efficiency** in private banks as evidenced by better cost-to-income ratios and DEA results
2. **Superior asset quality management** with lower NPAs, higher provision coverage, and better recovery rates
3. **More diversified revenue streams** with higher non-interest income ratios
4. **Better pricing power** as demonstrated by the NIM differential
5. **More selective lending practices** versus policy-directed lending in PSBs

However, the profitability gap narrowed somewhat in FY2021-22, suggesting potential convergence as PSBs implement reforms and digital transformation initiatives.

2. Asset Quality Dynamics

The persistent asset quality differential can be explained by:

1. **Lending practices and risk assessment** variations, with private banks generally employing more sophisticated credit scoring models
2. **Sectoral exposure differences**, with PSBs having historically higher exposure to stressed sectors like infrastructure, power, and textiles
3. **Recovery mechanisms**, with private banks demonstrating more aggressive recovery strategies
4. **Governance structures** that potentially allow for faster decision-making in private banks regarding NPA resolution
5. **Legacy NPAs** from pre-2015 lending that continue to impact PSB balance sheets

The gradual NPA reduction in recent years (2020-2022) reflects the positive impact of the Insolvency and Bankruptcy Code and enhanced recovery mechanisms.

3. Efficiency and Productivity Analysis

DEA results indicate that private banks operate closer to the efficient frontier, which may be attributed to:

1. **Technology adoption and digital banking penetration**, reducing operational costs
2. **Employee productivity** differences reflected in business and profit per employee metrics
3. **Branch rationalization strategies** with private banks focusing on optimal branch size and location
4. **Process optimization and automation** levels
5. **Outsourcing non-core functions** more effectively

However, when financial inclusion parameters are incorporated into the DEA model as outputs, the efficiency gap narrows significantly, suggesting that PSBs fulfill broader social objectives.

4. Impact of Regulatory and Policy Environment

The regulatory environment affects bank categories differently:

1. **Priority sector lending requirements** impact PSBs and private banks differently due to varied business models
2. **Recapitalization mechanisms**favor private banks' ability to raise capital from markets versus PSBs' dependence on government funding
3. **Corporate governance regulations** implementation varies across ownership structures
4. **Technology adoption mandates** have been implemented more efficiently by private banks
5. **Financial inclusion directives** have traditionally placed greater expectations on PSBs

Statistical evidence suggests that regulatory changes requiring higher provisioning and capital adequacy have disproportionately affected PSBs due to their pre-existing asset quality challenges.

Conclusions and Recommendations

1. Key Conclusions

Based on the comprehensive statistical analysis, several conclusions emerge:

1. Private sector banks consistently outperform public sector banks across most financial parameters, particularly in profitability metrics, asset quality indicators, and operational efficiency measures.
2. The performance gap widened considerably after 2015, coinciding with regulatory changes that enforced stricter asset classification and provisioning norms.
3. Public sector banks demonstrate comparative advantages in stability during crises, financial inclusion metrics, and priority sector lending fulfillment.
4. Bank size and market concentration show significant correlations with performance, but ownership structure remains a stronger determinant even after controlling for these factors.
5. The efficiency gap has begun narrowing in recent years (FY2020-2022), suggesting that reforms in public sector banks are yielding positive results.

2. Policy Recommendations

Based on the findings, the following recommendations are proposed:

1. **Governance reforms in public sector banks**

- Implement full Nayak Committee recommendations on board constitution
- Establish truly autonomous boards with reduced political interference
- Develop performance-linked incentive structures for management

2. **Strategic consolidation and specialization**

- Continue strategic mergers to achieve economies of scale
- Encourage specialization based on core competencies
- Develop differentiated banking models for specific market segments

3. **Technology transformation**

- Accelerate digital banking adoption across public sector banks
- Invest in analytics capabilities for credit assessment and monitoring
- Develop fintech partnerships to enhance service delivery

4. Asset quality management
- Establish specialized NPA management units with dedicated expertise
- Develop early warning systems using advanced analytics
- Implement sector-specific lending protocols based on risk assessment

5. Capital optimization strategies
- Develop phased plans for reducing government holdings while maintaining policy objectives
- Explore alternative capital raising mechanisms beyond direct government infusion
- Implement risk-based pricing to improve returns on capital

3. Limitations and Future Research Directions

This study has several limitations that present opportunities for future research

1. The aggregated analysis may mask bank-specific variations within each category; bank-level analysis could provide deeper insights.
2. The impact of recent reforms, particularly the formation of National Asset Reconstruction Company Ltd. (NARCL), is not fully captured due to recency.
3. The study does not fully account for differences in business models and customer segments targeted by different bank categories.
4. Digital banking parameters could not be comprehensively incorporated due to data limitations.

Future research could explore
- Branch-level efficiency differences using micro-level data
- Impact of ownership structure on customer satisfaction and service quality
- Comparative analysis including small finance banks and payments banks
- Detailed examination of technology adoption impacts on operational efficiency
- Cross-country comparative analysis with other mixed banking systems

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