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BANKING PERFORMANCE MEASUREMENT FOR INDIAN BANKS USING AHP AND TOPSIS

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Abstract

Multi-criteria decision modelling (MCDM) offers a range of procedures for evaluation problems requiring the ranking of a discrete set of alternatives, including the Analytic Hierarchy Process (AHP) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). These procedures have been widely applied for banking performance evaluation (Önder & Hepşen, 2013). The present study compared the outcomes of AHP and TOPSIS for evaluation of a sample of 35 Indian banks, including 19 public sector banks and 16 private sector banks. The variables used in the analysis pertained to the financial ratios corresponding to the CAMEL parameters. The weights for different parameters in the CAMEL model were obtained by factor analysis. The results of the study indicated an overall consistency between the rankings, resulting from the models. A significant difference was found in the performance between private sector banks and public sector banks. In particular, banks that were found to be consistently ranked high by both models can be taken as the best performers, and banks that were found to be consistently ranked low by both models can be taken as the worst performers. This would enable regulators and policy makers, on the one hand, to benchmark the performance of banks against that of best performers, and on the other hand, to take steps to improve the performance of worst performers. The results of the study also needed to be examined more carefully to identify the critical performance parameters for banks.

Keywords: multi-criteria decision modelling, AHP, TOPSIS, factor analysis.
JEL Classification:

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1. Introduction

Bank performance benchmarking and evaluation have become critically important in the dynamic banking environment in India in order to ensure sustained profitability and avoid undue risks. The Reserve Bank of India (RBI)

has taken several important steps to this end, particularly with the implementation of the recommendations of the Basel Committee for Banking Supervision, the Basel II norms. Currently, the RBI is in the process of implementing the revised Basel III norms, and is moving toward a system of Risk-Based Supervision (RBS) for monitoring bank performance.

There are several systems used for bank performance evaluation. The CAMEL model, originally used by U.S. regulators to determine when to conduct on-site examination of banks, is one of the most widely-used frameworks for bank performance evaluation (Sahajwala & van der Bergh, 2000). The five CAMEL parameters including. Capital Adequacy, Asset Quality, Management Soundness, Earnings Performance, and Liquidity Position, are essential for the sustainability of banks - insufficiency in any parameter would result in increased likelihood of bank failure.

2. Literature Review

There is extensive literature addressing bank performance evaluation. The CAMEL framework is a commonly-used methodology for bank performance assessment, using particular financial ratios to reflect different aspects of a bank's performance (Sahajwala & van der Bergh, 2000). Several studies used the CAMEL framework as a basis for comparison of bank performance, as well as bank group performance. Dash and Das (2013) compared the performance of public sector banks with private/foreign banks under the CAMELS framework. They found that private/foreign banks fared better than public sector banks on most of the CAMELS factors in the study period, and that the primary contributing factors for the better performance of private/foreign banks were Management Soundness, and Earnings and Profitability.

Several multi-criteria decision methods had been applied widely in banking performance measurement, including the Analytic Hierarchy Process (AHP), and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Some of the literature closely linked with the present study is reviewed in the following.

Several studies have applied AHP models to measure bank performance. Hunjak and Jacovcevi (2001) suggested the use of multi-criteria AHP, using both quantitative factors (viz. financial ratios) and qualitative factors (internal and external) in the evaluation process. Seçme, Bayrakdarogh, and Kahraman (2009) proposed a fuzzy AHP model for the banking system using both financial and non-financial performance criteria. Stankevičiene and Mencaitė (2012) used the AHP model to evaluate the performance of Lithuanian commercial banks.

Bayyurt (2013) compared the performance of the foreign and domestic deposit banks in Turkey using several MCDM methods, namely the DEA, TOPSIS, and ELECTRE III, using the Mann-Whitney U-test and the independent samples t-test. Önder and Hepşen (2013) proposed a performance evaluation model for Turkish banks using time-series forecasting methods and multi-criteria AHP and TOPSIS methodology.

Several other multi-criteria methods discussed in the literature include ELECTRE (Bayyurt, 2013), PROMETHEE (Mareschal & Brans, 1991; Mareschal & Mertens, 1992; Babic, Belak & Tomic-Plazibat, 1999; Kosmidou & Zopounidis, 2008; Doumpos & Zopounidis, 2011; Ginevičius & Podviezko, 2013), disaggregation techniques (Zopounidis, Despotis, & Stavropoulou, 1995; Spathis, Kosanidou, & Duompos, 2002), co-plot method (Raveh, 2000), grey relational analysis (Ho, 2006), classification techniques (Ioannidis, Pasiouras, & Zopounidis, 2010), balanced scorecard approach (Wua, Tzeng, & Chen, 2009), COPRAS (Ginevičius & Podviezko, 2013), and many others.

The present study attempted to integrate two approaches in bank performance measurement: multi-criteria decision models and multivariate statistical methods. The multi-criteria decision modelling approach focuses on ranking the banks according to the CAMEL parameters. The multivariate statistical approach, particularly factor analysis, is used to obtain appropriate weights for the different parameters in the CAMEL model. The scores so obtained are used to rank banks under the CAMEL dimensions, and compare the performance of public sector and private sector banks in India.

3. Data and Methodology

The objective of the present study was to integrate multivariate statistical methods with multi-criteria decision models in bank performance measurement. The study employed two different multi-criteria decision models to analyse bank performance: AHP and TOPSIS. The weights for the different parameters in the CAMEL model were obtained by factor analysis. The scores under the different models were in turn used to rank the sample banks, and compared the performance of public sector and private sector banks in India. The variables used in the analysis pertained to the financial ratios corresponding to the CAMEL parameters. These are discussed in the following (Dash & Das, 2013).

Capital Adequacy embodies the capability of a bank in terms of sufficient capital to shield against unexpected losses. It is required in order to maintain depositors' confidence and to prevent bankruptcy. In the current study, it was measured through three ratios: the Debt- Equity ratio, the Coverage ratio, and the Capital Adequacy ratio.

Asset Quality represents the nature of loans and advances the bank has made to generate interest income. Highly rated companies generally tend to be offered lower interest rate terms than lower rated, doubtful companies. Thus asset quality mirrors the type of debtors of the bank. The ratio used to capture this parameter in this study was Net NPA to Total Advances ratio.

Management Soundness is the parameter used to evaluate management quality, assigning higher value to better-managed banks and lower value to poorly-managed banks. It reflects the efficiency of management in generating business (top-line) and in maximising profits (bottom-line). In this study, it was measured via four ratios, namely. Total Investments to Total Assets ratio,

Total Advances to Total Deposits ratio, Business per Employee, and Profit per Employee.

Earnings Performance focuses on how a bank earns profits. This in turn describes the sustainability and growth in earnings in the future. In this study, it was measured through three ratios, namely Return on Net Worth, Interest Spread to Total Assets ratio, and Profit after Tax to Total Assets.

Liquidity Position is of prime importance in the banking business. In this study, it was measured using two ratios: Government Securities to Total Investment and Government Securities to Total Assets.

The data used for the study were related to a sample of 35 banks operating in India, of which 19 were public sector banks, and 16 were private sector banks, as listed in Table 1. The research period for the study was 2007-2011. The data for the study consisted of financial ratios based on the CAMEL framework described previously , obtained from the Capitaline database[1].

Table 1: List of Sample Banks

	Public Sector Banks		Private Sector Banks
1	Allahabad Bank	1	Axis Bank
2	Andhra Bank	2	Yes Bank
3	Bank of Baroda	3	Standard Chartered Bank
4	Bank of India	4	South Indian Bank
5	Canara Bank	5	Kotak Mahindra Bank
6	Corporation Bank	6	HDFC Bank
7	Central Bank of India	7	Federal Bank
8	Dena Bank	8	Dhanalaxmi Bank
9	Indian Overseas Bank	9	Development Credit Bank
10	Indian Bank	10	Karnataka Bank
11	Oriental Bank of Commerce	11	J &K Bank
12	Punjab National Bank	12	ING Vysya Bank
13	State Bank of India	13	Bank of Rajasthan
14	IDBI Bank	14	Citi Bank
15	Syndicate Bank	15	Tamilnad Mercantile Bank
16	UCO Bank	16	ICICI Bank
17	Union Bank of India		
18	United Bank		
19	Vijaya Bank		

[1]

The CAMEL variables, averaged across the five-year period, were taken for analysis, and the subsequent factor weights were used in conjunction with the multi-criteria procedures in AHP and TOPSIS (Önder and Hepşen, 2013). The scores under these models were in turn used to rank the sample banks, and to identify the good and bad performers. The Mann-Whitney test was used to compare the overall performance of public and private sector banks under each of the models.

4. Findings

The weights for the different parameters in the CAMEL model, obtained by factor analysis, are presented in Table 2.

Table 2: Weights of the Parameters in the CAMEL Model

Capital Adequacy	
Debt/Equity ratio	-0.368
Coverage ratio	0.379
Capital Adequacy ratio	0.333
Asset Quality	
Net NPA/Total Advances	1.000
Management Soundness	
Total Investment/Total Assets	-0.264
Total Advances/Total Deposits	0.320
Business per Employee	0.335
Profit per Employee	0.341
Earnings Performance	
Return on Net Worth	0.399
Interest Spread/Total Assets	0.350
PAT/Total Assets	0.516
Liquidity	
Govt Sec/Total Investment	0.512
Govt Sec/Total Asset	0.512

The results of the analysis under the CAMEL model, and under AHP and TOPSIS are presented in Tables 3, 4, and 5, respectively.

Table 3: Bank Rankings under the CAMEL Scores

Bank	Capital Adequacy	Asset Quality	Management Soundness	Earnings Performance	Liquidity Position	CAMEL Score
Standard Chartered Bank	0.7994	0.4867	1.0000	1.0000	0.1228	0.6818
Indian Bank	0.5496	0.8953	0.2791	0.8099	0.7891	0.6646
Andhra Bank	0.4102	0.9446	0.3358	0.6436	0.9452	0.6559
Citi Bank	0.7097	0.5287	0.8569	0.8444	0.3321	0.6544
Corporation Bank	0.4443	0.8624	0.4521	0.5578	0.9242	0.6482
Punjab National Bank	0.4182	0.7495	0.2987	0.6930	0.9337	0.6186
Yes Bank	0.6588	1.0000	0.6059	0.7652	0.0438	0.6148
Bank of Baroda	0.4324	0.8398	0.3897	0.5626	0.8146	0.6078
Oriental Bank of Commerce	0.4662	0.6437	0.4247	0.4433	0.9602	0.5876
IDBI Bank	0.3369	0.4959	0.7807	0.3715	0.9363	0.5843
Allahabad Bank	0.3914	0.6376	0.2765	0.5998	1.0000	0.5811
HDFC Bank	0.7248	0.8439	0.2412	0.8260	0.2600	0.5792
Bank of India	0.3021	0.6283	0.3329	0.6036	0.9751	0.5684
Federal Bank	0.8864	0.8419	0.2994	0.6278	0.1774	0.5666
Axis Bank	0.5776	0.8234	0.5185	0.8293	0.0000	0.5498
Union Bank of India	0.3240	0.6961	0.3147	0.6354	0.7615	0.5463
Canara Bank	0.3818	0.5349	0.3353	0.5837	0.8597	0.5391
Kotak Mahindra Bank	1.0000	0.1694	0.2453	0.8230	0.4152	0.5306
Tamilnad Mercentile Bank	0.9175	0.5493	0.1798	0.7682	0.0685	0.4967
Indian Overseas Bank	0.3189	0.4168	0.2493	0.5606	0.8952	0.4881
Dena Bank	0.2022	0.3901	0.2498	0.5594	0.8934	0.4590
J & K Bank	0.5557	0.6355	0.2541	0.5917	0.0739	0.4222

(continued)

Bank	Capital Adequacy	Asset Quality	Management Soundness	Earnings Performance	Liquidity Position	CAMEL Score
South Indian Bank	0.4449	0.7320	0.2378	0.5178	0.1729	0.4211
Vijaya Bank	0.2346	0.5493	0.2185	0.4089	0.6752	0.4173
Central Bank of India	0.0790	0.4641	0.1488	0.4049	0.9159	0.4026
Syndicate Bank	0.1350	0.5862	0.2372	0.5049	0.4872	0.3901
State Bank of India	0.3968	0.1817	0.2194	0.4648	0.5808	0.3687
ING Vysya Bank	0.4138	0.5965	0.2001	0.3650	0.2622	0.3675
ICICI Bank	0.5051	0.2567	0.5139	0.4427	0.1092	0.3655
Karnataka Bank	0.5376	0.4251	0.1783	0.4374	0.1761	0.3509
UCO Bank	0.0000	0.1992	0.2045	0.4366	0.9073	0.3495
Dhanlaxmi Bank	0.3344	0.5749	0.1110	0.3711	0.2948	0.3373
United Bank	0.2442	0.2988	0.0727	0.3063	0.6336	0.3111
Bank of Rajasthan	0.2055	0.6686	0.0401	0.3092	0.1694	0.2786
Development Credit Bank	0.6077	0.0000	0.0000	0.0000	0.2464	0.1708

According to the results of the CAMEL model, the 10 best performing banks were Standard Chartered Bank, Indian Bank, Andhra Bank, Citi Bank, Corporation Bank, Punjab National Bank, Yes Bank, Bank of Baroda, Oriental Bank of Commerce, and IDBI Bank, while the 10 worst performing banks were Development Credit Bank, Bank of Rajasthan, United Bank, Dhanlaxmi Bank, UCO Bank, Karnataka Bank, ICICI Bank, ING Vysya Bank, State Bank of India, and Syndicate Bank.

Table 4: Bank Rankings under the AHP Scores

Bank	Capital Adequacy	Asset Quality	Management Soundness	Earnings Performance	Liquidity Position	AHP Score
Standard Chartered Bank	0.0632	0.0339	0.0770	0.0496	0.0211	0.0354
Citi Bank	0.0542	0.0314	0.0667	0.0421	0.0249	0.0313
Yes Bank	0.0491	0.0031	0.0488	0.0383	0.0196	0.0305

(continued)

Bank	Capital Adequacy	Asset Quality	Management Soundness	Earnings Performance	Liquidity Position	AHP Score
Federal Bank	0.0720	0.0126	0.0269	0.0317	0.0221	0.0280
HDFC Bank	0.0557	0.0125	0.0227	0.0412	0.0235	0.0261
Axis Bank	0.0409	0.0137	0.0426	0.0414	0.0188	0.0260
Indian Bank	0.0381	0.0094	0.0254	0.0405	0.0331	0.0255
Tamilnad Mercentile Bank	0.0751	0.0302	0.0183	0.0385	0.0201	0.0244
Kotak Mahindra Bank	0.0835	0.0529	0.0230	0.0411	0.0264	0.0242
Corporation Bank	0.0274	0.0114	0.0378	0.0284	0.0356	0.0236
Andhra Bank	0.0240	0.0065	0.0295	0.0325	0.0360	0.0231
Bank of Baroda	0.0262	0.0127	0.0333	0.0286	0.0336	0.0218
Punjab National Bank	0.0248	0.0182	0.0268	0.0349	0.0357	0.0208
Oriental Bank of Commerce	0.0296	0.0245	0.0358	0.0229	0.0362	0.0200
IDBI Bank	0.0166	0.0334	0.0613	0.0194	0.0358	0.0200
Allahabad Bank	0.0221	0.0249	0.0253	0.0304	0.0369	0.0180
J & K Bank	0.0387	0.0250	0.0236	0.0300	0.0202	0.0175
Union Bank of India	0.0153	0.0214	0.0280	0.0321	0.0326	0.0173
Bank of India	0.0131	0.0254	0.0293	0.0306	0.0365	0.0168
Canara Bank	0.0211	0.0310	0.0295	0.0296	0.0344	0.0167
South Indian Bank	0.0275	0.0192	0.0225	0.0264	0.0220	0.0158
ICICI Bank	0.0336	0.0477	0.0422	0.0228	0.0208	0.0144
Indian Overseas Bank	0.0148	0.0381	0.0233	0.0285	0.0350	0.0127
Karnataka Bank	0.0368	0.0376	0.0182	0.0226	0.0220	0.0124

(continued)

Bank	Capital Adequacy	Asset Quality	Management Soundness	Earnings Performance	Liquidity Position	AHP Score
ING Vysya Bank	0.0244	0.0273	0.0198	0.0191	0.0236	0.0119
Dena Bank	0.0030	0.0397	0.0233	0.0284	0.0350	0.0100
Vijaya Bank	0.0063	0.0302	0.0211	0.0212	0.0311	0.0099
State Bank of India	0.0226	0.0522	0.0212	0.0239	0.0294	0.0090
Dhanlaxmi Bank	0.0163	0.0286	0.0134	0.0194	0.0242	0.0089
Syndicate Bank	-0.0038	0.0279	0.0224	0.0258	0.0277	0.0088
Central Bank of India	-0.0094	0.0353	0.0161	0.0210	0.0354	0.0056
Bank of Rajasthan	0.0034	0.0230	0.0084	0.0164	0.0219	0.0054
United Bank	0.0072	0.0452	0.0107	0.0163	0.0303	0.0039
Development Credit Bank	0.0439	0.0631	0.0055	0.0016	0.0233	0.0022
UCO Bank	-0.0174	0.0511	0.0201	0.0226	0.0353	0.0019

According to the results of the AHP model, the 10 best performing banks were Standard Chartered Bank, Citi Bank, Yes Bank, Federal Bank, HDFC Bank, Axis Bank, Indian Bank, Tamilnad Mercentile Bank, Kotak Mahindra Bank, and Corporation Bank, while the 10 worst performing banks were UCO Bank, Development Credit Bank, United Bank, Bank of Rajasthan, Central Bank of India, Syndicate Bank, Dhanlaxmi Bank, State Bank of India, Vijaya Bank, and Dena Bank.

Table 5: Bank rankings under the TOPSIS scores

Bank	Ideal	Anti-ideal	TOPSIS Score
Standard Chartered Bank	0.2090	0.6110	0.7451
Citi Bank	0.2237	0.5401	0.7072
Yes Bank	0.2463	0.5366	0.6854
Federal Bank	0.3017	0.5311	0.6377
Axis Bank	0.2947	0.4771	0.6182
HDFC Bank	0.3271	0.4933	0.6013
Tamilnad Mercentile Bank	0.3590	0.5089	0.5864
Kotak Mahindra Bank	0.3935	0.5268	0.5724

(continued)

Bank	Ideal	Anti-ideal	TOPSIS Score
Indian Bank	0.3466	0.4596	0.5701
Corporation Bank	0.3527	0.4218	0.5446
Andhra Bank	0.3818	0.4264	0.5276
Bank of Baroda	0.3714	0.4035	0.5207
IDBI Bank	0.3946	0.3919	0.4983
Punjab National Bank	0.3930	0.3888	0.4973
Oriental Bank of Commerce	0.3777	0.3715	0.4959
J & K Bank	0.3934	0.3764	0.4890
South Indian Bank	0.4227	0.3527	0.4548
Allahabad Bank	0.4211	0.3489	0.4531
Union Bank of India	0.4280	0.3478	0.4483
ICICI Bank	0.4154	0.3356	0.4468
Canara Bank	0.4223	0.3298	0.4385
Bank of India	0.4382	0.3343	0.4328
Karnataka Bank	0.4513	0.3148	0.4109
ING Vysya Bank	0.4632	0.2979	0.3914
Indian Overseas Bank	0.4761	0.2823	0.3722
Dhanlaxmi Bank	0.5076	0.2648	0.3428
Vijaya Bank	0.5080	0.2571	0.3360
State Bank of India	0.5033	0.2516	0.3333
Syndicate Bank	0.5290	0.2599	0.3295
Dena Bank	0.5167	0.2536	0.3293
Development Credit Bank	0.5933	0.2831	0.3230
Bank of Rajasthan	0.5632	0.2484	0.3060
Central Bank of India	0.5814	0.2174	0.2721
United Bank	0.5732	0.1838	0.2428
UCO Bank	0.6253	0.1808	0.2243

According to the results of the TOPSIS model, the 10 best performing banks were Standard Chartered Bank, Citi Bank, Yes Bank, Federal Bank, Axis Bank, HDFC Bank, Tamilnad Mercentile Bank, Kotak Mahindra Bank, Indian Bank, and Corporation Bank, while the 10 worst performing banks were UCO Bank, United Bank, Central Bank of India, Bank of Rajasthan, Development Credit Bank, Dena Bank, Syndicate Bank, State Bank of India, Vijaya Bank, and Dhanlaxmi Bank.

The common best performing banks under both models were Standard Chartered Bank, Indian Bank, Citi Bank, Corporation Bank, and Yes Bank; while HDFC Bank, Federal Bank, Axis Bank, and Kotak Mahindra Bank also

came within the best performing banks under AHP and TOPSIS. The common worst-performing banks under all three of the above models were UCO Bank, United Bank, Development Credit Bank, Bank of Rajasthan, State Bank of India, Syndicate Bank, and Dhanlaxmi Bank; while Vijaya Bank, Central Bank of India, and Dena Bank also came within the worst performing banks under AHP and TOPSIS.

There was also overall consistency found between the rankings resulting from all the models used, viz. high consistency between AHP and TOPSIS rankings ($\rho = 0.987$), and between CAMEL rankings, and AHP and TOPSIS rankings ($\rho = 0.859$ and $\rho = 0.804$, respectively).

The results of the Mann-Whitney test comparing the performance of public sector banks and private sector banks under the models are presented in Table 6.

Table 6: Mann-Whitney Tests for Differences between Public Sector and Private Sector Banks

	Type	n	Mean Rank	Mann-Whitney U	z Stat	p-Value
CAMEL score	public sector	19	19.84	117.00	-1.159	0.123
	private sector	16	15.81			
	total	35				
AHP score	public sector	19	15.00	95.00	-1.887	0.0295
	private sector	16	21.56			
	total	35				
TOPSIS score	public sector	19	14.68	89.00	-2.086	0.0185
	private sector	16	21.94			
	total	35				

The results of the Mann-Whitney tests for the AHP and TOPSIS models indicated that, overall, private sector banks were performing significantly better than public sector banks. However, the results of the Mann-Whitney test for the CAMEL model indicated no significant difference in performance between public sector and private sector banks.

5. Discussion and Conclusion

The results of the study showed that, though the AHP and TOPSIS models have resulted in a different ranking of the sample banks, there was overall consistency between the rankings resulting from the models. In particular, banks that were found to be consistently ranked high by both models can be taken as the best performers, and banks that were found to be consistently ranked low by both models can be taken as the worst performers. This would enable regulators and policy makers, on the one hand, to benchmark the performance of banks against that of best performers, and on the other hand, to take steps to improve the performance of worst performers. The AHP and TOPSIS models were found to effectively distinguish the performance of private sector banks from that of public sector banks. The results of the study need to be examined more carefully to identify the critical performance parameters for banks.

The results of the study seemed to have under-rated the performance of larger banks such as SBI, HDFC Bank, and ICICI Bank. However, this is consistent with many other studies, for example, Gupta (2014) analysed 26 public sector banks using the CAMEL model in the period 2009-13, and found SBI to persistently fall in the bottom 30th percentile of public sector banks in all five dimensions. Similarly, Prasad, Ravindes and Reddy (2011) analysed 26 public sector banks and 13 private sector banks using the CAMEL model in the period 2007-11, and found SBI near the bottom 20th-25th percentile in terms of capital adequacy, asset quality, management soundness, and earnings potential, and top 25th percentile in terms of liquidity; they found HDFC Bank near the median in terms of capital adequacy, asset quality, and management soundness, in the top 5th percentile in terms of earnings potential, and top 30th percentile in terms of liquidity; and they found ICICI Bank in the bottom 10th percentile in terms of capital adequacy and asset quality, in the top 5th percentile in terms of management soundness, near the median in terms of earnings potential, and in the top 40th percentile in terms of liquidity.

The difference between the perceived performance of the large banks and their scores as found in the current study could be due to the parameters considered and the analytical techniques employed. Many studies defined performance in very narrow terms, often in terms of profitability only, or using measures such as market share, customer base, number of branches, number of employees, number of ATMs, and so on, which are indicators of important aspects of banking, such as outreach and customer service, but which are highly positively correlated with size. Some analytical techniques also tend to have a size bias; for example, efficiency studies using data envelopment analysis (DEA) tend to over-rate larger banks. The CAMEL model was adopted for the study, because it is widely accepted as a comprehensive measurement model for banking performance (Sahajwala & van de Bergh, 2000). Further more, financial ratios provide better indicators of relative performance than absolute financial figures, as they avoid the size bias, and using several different disaggregating ratios for each dimension tends to give more reliable measures.

There were several limitations inherent in the current study. The study was based on a sample of only 35 banks, over only a five-year period (2007-11), which was the period of the global financial crisis, which seriously affected banking systems worldwide. Thus, the results of the study may be period specific, and may not be generalisable. Also, the approach followed in the current study considered only some performance parameters, and did not consider some qualitative aspects of banking performance, such as management performance and staff efficiency. Further more, the study did not analyse the sensitivity of any the scores to the parameter weights. Also, the study used factor analysis, which determined weights in order to maximise the variance explained, but which may not reflect the importance of the parameters in banking performance.

There is a vast scope for further research in the area of bank performance and risk measurement, particularly as the banking sector is highly dynamic in nature. Several other multi-criteria models may be used to analyse banking performance to provide alternative perspectives to regulators and policy makers, for example, ELECTRE and PROMETHEE methodologies can be used to identify banks that dominate over other banks in terms of performance, DEA methodology may be used to identify inefficient banks, and VIKOR methodology may be used to identify critical trade-offs in banking performance.

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