A Model for Bank Performance Measurement Integrating Multivariate Factor Structure with Multi-Criteria PROMETHEE Methodology

Mihir Dash

Head of Department, Department of Quantitative Methods

School of Business, Alliance University

Chikkahagade Cross, Anekal, Bangalore, India-562106

Tel: 91-99-518 2465   E-mail: mihirda@rediffmail.com

Abstract

The global financial crisis and the subsequent Euro-zone crises have resulted in widespread failure of banking systems worldwide. The Indian banking system, which was initially hailed to be unaffected by the crises, was affected indirectly, mainly on account of growing trade and financial integration with the global economy. Although Indian banks were not pushed to the point of insolvency, bank performance benchmarking and evaluation have become important in the dynamic banking environment in India in order to ensure sustained profitability and avoid undue risks.

The CAMELS model is one of the most widely-used frameworks for bank performance evaluation (Sahajwala and van der Bergh, 2000). The CAMELS methodology provides a broader view of bank performance than single ratios such as return on equity, particularly as it takes account of both profitability and risk factors in representing bank performance. Several studies have proposed multi-criteria decision models for bank performance measurement (Doumpos and Zopounidis, 2011).

The objective of the present study is to integrate multivariate and multi-criteria decision models in bank performance measurement. The study uses the factor structure of the CAMELS model to derive weights for the different criteria in the PROMETHEE methodology. The resulting PROMETHEE scores are used to rank banks under different dimensions, and to compare the performance of public sector and private sector banks in India.

Keywords: bank performance measurement, CAMELS model, factor structure, PROMETHEE methodology

JEL Classification: G20

Introduction

Bank performance evaluation has gained greatly in importance in recent years. The global financial crisis and the subsequent Euro-zone crises have resulted in widespread failure of banking systems worldwide. The collapse of some of the most prominent banks in the world, including the Lehman Brothers and Washington Mutual Bank, along with several near-failures which had to be bailed out of crisis by the U.S. Government, highlighted the inadequacy of bank evaluation systems in detecting/predicting bank insolvency.

The Indian banking system, which was initially hailed to be unaffected by the crises, was affected indirectly, mainly on account of growing trade and financial integration with the global economy. Though Indian banks were not pushed to the point of insolvency, bank performance benchmarking and evaluation have become important in the dynamic banking environment in India in order to ensure sustained profitability and avoid undue risks.

There are several systems used for bank performance evaluation. The CAMELS model is one of the most widely-used frameworks for bank performance evaluation (Sahajwala and van der Bergh, 2000). Originally, the CAMEL framework was used by regulators in the U.S. to determine when to conduct on-site examination of a bank; it is still used by regulators to evaluate bank performance. The five CAMEL parameters, viz. Capital Adequacy, Asset Quality, Management Soundness, Earnings and Profitability, and Liquidity, are critical for the survival of banks - inadequacy in any parameter would result in increased likelihood of bank failure. The sixth parameter, Sensitivity to Market Risk, was added to these former parameters in order to make this method more comprehensive.

The present study attempts to integrate two approaches in bank performance measurement: multivariate methods and multi-criteria decision models. The multivariate approach examines the dimensionality of the CAMELS system. The multi-criteria decision modeling approach focuses on ranking the banks according to the dimensions inherent in the CAMELS system. Further, the factor structure of the CAMELS model is used to derive weights for the different criteria in the multi-criteria decision model. The resulting scores are used to rank banks under different dimensions, and compare the performance of public sector and private sector banks in India.

Literature Review

There is extensive literature addressing banking performance evaluation. The CAMELS framework in particular is a widely-used methodology for bank performance assessment, using particular financial ratios to reflect different aspects of a bank's performance (Sahajwala and van der Bergh, 2000). Barr et al (2002) found that the CAMEL ratings were consistent with the efficiency scores obtained through Data Envelopment Analysis.

Beaver (1966, 1968) and Altman (1968) initiated the use of financial ratios for bankruptcy prediction. Maishanu (2004) extended Altman's z-score model for banks, suggesting eight financial ratios to assess the financial health of a bank. Mous (2005) applied decision tree models and multiple discriminant models for bankruptcy prediction in banks, using profitability, liquidity, leverage, and turnover ratios, and suggested that the decision tree

approach performed better than the discriminant model approach.

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 two contributing factors for the better performance of private/foreign banks were Management Soundness and Earnings and Profitability.

Njoku (2011) studied the factor structure of CAMEL in order to develop an anatomic model of bank performance, using factor weights. The anatomy framework modelled a bank's financial situation in seven structural parameters, including market presence, macro-economic condition, deposit mobilisation, prudence, earnings quality, market power and capital confidence. Njoku and Inanga (2012) applied the anatomic model in interpreting critical issues commonly reported in the 2008-2009 global banking crises.

Several studies have applied factor analysis to develop rating methods for life insurance service providers. Hsiao (2006, 2008) developed the CAMEL-S model based on fourteen financial variables and reported its consistency with DEA efficiency scores. Yakob et al (2012) applied factor analysis to a set of twenty-three financial ratios to develop a CAMEL model for rating life insurance service providers.

Klomp and de Haan (2011) applied dynamic factor analysis with a set of twenty-five financial variables under the CAMELS framework in order to construct measures for bank risk. Popovska (2014) applied factor analysis to the six CAMELS dimensions in order to develop a measure for bank stability. Maliszewski (2009) and Bhattacharyay (2011) had also proposed such a measure.

Several multi-criteria decision methods have been applied widely in banking performance measurement. Some of the most commonly-applied techniques include Data Envelopment Analysis (DEA), Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), ELimination Et Choix Traduisant la REalité (ELECTRE), VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR), and Preference Ranking Organization METHod for Enrichment of Evaluation (PROMETHEE). Some of the literature closely linked with the present study is reviewed in the following.

Several studies have applied DEA models to measure bank efficiency (Parkan & Liu, 1999; Halkos & Salamouris, 2004; Kao & Liu, 2004; Avkiran, 2010; Fallah et al, 2011; Dash and Charles, 2012; Minh et al, 2013; Doumpos and Zopounidis, 2013; Dash and Vegesna, 2014). Hunjak and Jakovcevic (2001) proposed a methodology for bank performance measurement based on multi-criteria AHP, enabling the consideration of both quantitative factors (viz. financial ratios) and qualitative factors (internal and external) in the evaluation process. They applied their model in the context of Croatian banks. Seçme et al (2009) proposed a fuzzy AHP model for the banking system using both financial and non-financial performance criteria. Stankeviciene and Mencaite (2012) used the AHP model to evaluate the performance of Lithuanian commercial banks. They used a system of indicators and assigned each indicator a different weight reflecting its significance based on the needs and priorities of

both internal and external evaluators. Cetin & Cetin (2010) used multi-criteria VIKOR to rate Turkish banks according to their overall financial performance. Rezaei and Gheibdoust (2014) used VIKOR to rank banks based on capital adequacy, asset quality, liquidity, structure of capital expenditures and profitability. Several studies have used the PROMETHEE methodology for measuring bank performance (Mareschal & Brans, 1991; Mareschal & Mertens, 1992; Babic et al, 1999; Kosmidou & Zopounidis, 2008; Doumpos & Zopounidis, 2011; Ginevičius and Podviezko, 2013).

Bayyurt (2013) compared the performance of the foreign and domestic deposit banks in Turkey using several MCDM methods, viz. DEA, TOPSIS, and ELECTRE III, using the Mann-Whitney U-test and the independent samples t-test. The results of the study showed that foreign-owned banks performed better than domestic banks, as foreign banks could find cheaper international funds, and domestic banks had more employees than foreign banks for similar banking functions, resulting in lower employee productivity. Önder and Hepşen (2013) proposed a performance evaluation model for Turkish banks using time series forecasting methods and multi-criteria AHP and TOPSIS methodology. They applied the model under ten performance categories as prescribed by the Bank Association of Turkey: capital ratios, balance sheet ratios, assets quality, liquidity, profitability, income-expenditure structure, share in sector, share in group, branch ratios, and activity ratios.

Several other methods have also been applied, including disaggregation techniques (Zopounidis et al, 1995; Spathis et al, 2002), co-plot method (Raveh, 2000), grey relational analysis (Ho, 2006), classification techniques (Ioannidis et al, 2010), balanced scorecard approach (Wua et al, 2009), COPRAS (Ginevičius and Podviezko, 2013), and several others. Rosenzweig et al (2013) used a goal programming model for business strategies of commercial banks. The criteria for the model were profitability, security/risk and liquidity. The indicators were aggregated into a score which reduced all the relevant information about bank operations into an index using which the banks can be compared and ranked.

Thus, several studies have used factor analysis to develop composite measures of bank performance and risk, particularly in the context of the CAMELS model, and several studies have employed multi-criteria decision models in bank performance measurement. The present study examines the factor structure of the CAMELS model in bank performance in India.

Data and Methodology

The objective of the present study is to integrate multivariate and multi-criteria decision models in bank performance measurement. The study uses the factor structure of the CAMELS model to derive weights for the different criteria in the PROMETHEE methodology. The resulting PROMETHEE scores are used to rank banks under different dimensions, and compare the performance of public sector and private sector banks in India. The variables used in the analysis pertain to the financial ratios corresponding to the CAMELS parameters. These are discussed in the following (refer Dash and Das, 2013).

Capital Adequacy represents the capacity of a bank in terms of sufficient capital to absorb unexpected losses. It is required in order to maintain depositors' confidence and to prevent

the bank from going insolvent. In the current study, it is measured with the help of 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 given lower interest rate terms than lower-rated, doubtful companies. Thus asset quality reflects the type of debtors of the bank. The ratio used to capture this parameter in this study is Net NPA to Total Advances ratio.

Management Soundness is the parameter used to evaluate management quality, assigning premium to better-managed banks and discounting poorly-managed banks. It involves analysis of efficiency of management in generating business (top-line) and in maximizing profits (bottom-line). In this study, it is measured through four ratios, viz. Total Investments to Total Assets ratio, Total Advances to Total Deposits ratio, Business per Employee, and Profit per Employee.

Earnings Performance emphasises on how a bank earns its profits. This in turn explains the sustainability and growth in earnings in the future. In this study, it is measured via 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 the study, it is measured using two ratios: Government Securities to Total Investment and Government Securities to Total Assets.

Sensitivity to Market Risk considers the ability of a bank to identify, measure, monitor, and control market risk. In the study, it is measured by Beta, i.e. the systematic risk of the bank's stock returns.

The data for the study pertained to a sample of thirty-five banks operating in India, of which nineteen were public sector banks, and sixteen were private sector banks, listed in Table 1 below. The research period for the study was 2007-2011. The data for the study consists of financial ratios based on the CAMELS framework described above, obtained from the Capitaline database[1].

---

[1] www.capitaline.com

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
4	Bank of India	4	South Indian Bank
5	Canara Bank	5	Kotak Mahindra
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
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		

The CAMELS variables, averaged across the five-year period, were taken for the factor analysis, and the subsequent factor weights were used in conjunction with a multi-criteria procedure, PROMETHEE II (Doumpos and Zopounidis, 2011).

Following the PROMETHEE methodology, the partial preference indices were computed using the linear function

$$
\pi_k\left(x_{ik}, x_{jk}\right) = \begin{cases} 0 & if\ x_{ik}\ \leq\ x_{jk} \\ \frac{x_{ik} - x_{jk}}{p_k} & if\ 0\ \leq\ x_{ik} - x_{jk}\ \leq\ p_k \\ 1 & if\ x_{ik} - x_{jk} >\ p_k \end{cases} ,
$$

where the preference threshold p_k was taken to be equal to one standard deviation of the underlying variable. The partial evaluation scores were computed as $\varphi_k^+(x_i) = \frac{1}{m-1}\sum_{j\neq i}\pi_k\left(x_{ik}, x_{jk}\right)$ and $\varphi_k^-(x_i) = \frac{1}{m-1}\sum_{j\neq i}\pi_k\left(x_{jk}, x_{ik}\right)$, with $\varphi_k(x_i) = \varphi_k^+(x_i) - \varphi_k^-(x_i)$, and the final PROMETHEE score was computed as $\Phi(x_i) = \sum_k w_k\varphi_k(x_i)$.

The PROMETHEE scores computed as above were used to identify the good performers and the bad performers. Consistency of the PROMETHEE scores was analysed using Spearman rank correlation. Also, the PROMETHEE scores were used to compare the performance of public sector and private sector banks using the non-parametric Mann-Whitney U-test.

Findings

The descriptive statistics of the CAMELS parameters is presented in Table 2 below.

Table 2. Descriptive Statistics of CAMELS parameters

	public sector		private sector	
	mean	**std dev**	**mean**	**std dev**
Debt/Equity ratio	18.8253	3.3498	13.4292	3.4603
Coverage ratio	4.262%	1.240%	7.312%	2.150%
Capital Adequacy ratio	12.232%	0.857%	13.615%	2.303%
Net NPA/Total Advances	0.921%	0.436%	0.938%	0.516%
Total Investment/Total Assets	27.217%	2.186%	29.392%	4.123%
Total Advances/Total Deposits	72.007%	8.334%	72.948%	11.279%
Business per Employee	8.1363	3.3084	7.4585	3.0529
Profit per Employee	0.0507	0.0188	0.0703	0.0615
Return on Net Worth	19.474%	3.954%	14.800%	5.052%
Interest Spread/Total Assets	0.372%	0.081%	0.578%	0.315%
PAT/Total Assets	0.858%	0.254%	1.005%	0.550%
Govt Sec/Total Investment	1.195%	0.108%	0.754%	0.092%
Govt sec/Total Asset	0.324%	0.026%	0.218%	0.025%
Beta	1.1637	0.2266	0.8538	0.5905

The average CAR was well above the Basel II required level of 9%, and within the Basel III required level of 11%-13.5%[2]. Asset quality was generally stable across the research period, with the Net NPA ratio controlled to below 1%, significantly lower than its 2004 levels (about 7%). There was also a marked improvement in Management Soundness, especially in Business per Employee and Profit per Employee. However, Earnings Performance was relatively stable, especially Profit after Tax to Total Assets at around 1%, with some improvement in Return on Net Worth and Interest Spread in 2011. There was a decrease in Liquidity, with respect to Government Securities to both Total Investments and Total Assets. Sensitivity to Market Risk was also generally stable, with the average beta at around 1.

The results of the factor analysis are presented in Table 3 below.

---

[2] http://en.wikipedia.org/wiki/Basel_II

Table 3. Factor Analysis: Rotated Component Matrix

	Components				
	F1	*F2*	*F3*	*F4*	*F5*
Debt/Equity ratio				0.686	
Coverage ratio			0.688		
Capital Adequacy ratio			0.768		
Net NPA/Total Advances				0.738	
Total Investment/Total Assets	0.876				
Total Advances/Total Deposits	0.846				
Business per Employee	0.899				
Profit per Employee	0.888				
Return on Net Worth					0.930
Interest Spread/Total Assets			0.560		
PAT/Total Assets					0.626
Govt Sec/Total Investment		0.957			
Govt sec/Total Asset		0.941			
Beta				0.734	
%age of variance explained	*26.03%*	*16.88%*	*15.22%*	*14.61%*	*13.73%*

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

K.M.O. Measure of Sampling Adequacy: 0.652

Bartlett's Test of Sphericity: Chi-sq = 544.99, p = 0.000**

Total Variance Explained: 86.46%

The K.M.O. measure of sampling adequacy was moderate, and Bartlett's test was statistically significant, suggesting multi-collinearity of the variables. The results of the factor analysis identified five underlying factors, together explaining 86.46% of the overall variation in the variables.

The first factor (F1) loaded highly on four variables, viz. Total Investments to Total Assets, Total Advances to Total Deposits, Business per Employee, and Profit per Employee. Thus, this factor captures the Management Soundness dimension, and explains the maximum percentage of the overall variation in the variables.

The second factor (F2) loaded highly on Government Securities to Total Investments and Government Securities to Total Assets. Thus, this factor reflects the Liquidity dimension.

The third factor (F3) loaded highly on the Coverage ratio, the CAR, and the Interest Spread to Total Assets ratio. The first two variables relate to Capital Adequacy, while the third relates to Earnings Performance. This suggests that the Capital Adequacy of banks should also be measured in light of the Interest Spread to Total Assets ratio, as they are closely correlated.

The fourth factor (F4) combined three critical ratios. They were the Debt-Equity ratio, the Net NPA to Total Advances ratio, and Beta. The Debt-Equity ratio reflects Capital Adequacy, the Net NPA ratio indicates Asset Quality of banks, and Beta represents Sensitivity to Market Risk.

Thus, although these variables represent different parameters of the CAMELS framework, yet they are closely correlated. In fact, they all measure different types of risk; the Debt-Equity ratio measures financial risk, Net NPA ratio measures exposure to credit risk, and Beta measures systematic risk. Thus, the fourth factor may be interpreted as the Risk factor.

Lastly, the fifth factor (F5) loaded highly on Return on Net Worth and PAT to Total Assets ratio. Thus, this factor reflects the Earnings Performance dimension.

Based on the identified factors and their corresponding factor coefficients, the following weights were derived (insignificant coefficients were dropped).

Management Soundness	
Total Investment/Total Assets	0.2496
Total Advances/Total Deposits	0.2411
Business per Employee	0.2562
Profit per Employee	0.2531
Liquidity	
Govt Sec/Total Investment	0.5042
Govt Sec/Total Asset	0.4958
Capital Adequacy	
Coverage ratio	0.3413
Capital Adequacy ratio	0.3810
Interest Spread/Total Assets	0.2778
Risk	
Debt/Equity ratio	0.3179
Net NPA/Total Advances	0.3420
Beta	0.3401
Earnings Performance	
Return on Net Worth	0.5977
PAT/Total Assets	0.4023

The final PROMETHEE scores for these dimensions are presented in Tables 4-8 in the Appendix. The top five and bottom five performers for each dimension and for each criterion within each dimension is highlighted in green and red, respectively.

The sample banks exhibited mixed performance along the Management Soundness dimension. Overall, the best performing banks were: IDBI Bank, Yes Bank, Axis Bank, Citi Bank, and ICICI Bank, while the worst performing banks were: Dhanalaxmi Bank, Central Bank of India, United Bank, Bank of Rajasthan, and Development Credit Bank. The overall PROMETHEE scores for Management Soundness were significantly correlated with the PROMETHEE scores for Profit per Employee (ρ = 0.913), followed by Business per Employee (ρ = 0.655), and Total Advances/Total Deposits (ρ = 0.546), and were not significantly correlated with the PROMETHEE score for Total Investment/Total Assets (ρ = 0.013). Total Investment/Total Assets was significantly negatively correlated with Business

per Employee (ρ = -0.493) and Total Advances/Total Deposits (ρ = -0.480), with most banks having reverse ranks in the latter and the former, except for Kotak Mahindra Bank. Of course, Profit per Employee and Business per Employee were significantly correlated (ρ = 0.760), and Total Advances/Total Deposits was significantly correlated with both (ρ = 0.503 and ρ = 0.448, respectively).

The sample banks exhibited much more consistency along the Liquidity dimension. Overall, the best performing banks were: Allahabad Bank, Oriental Bank of Commerce, Bank of India, IDBI Bank, and Andhra Bank, while the worst performing banks were: Axis Bank, Yes Bank, Tamilnad Mercentile Bank, J & K Bank, and ICICI Bank. The overall PROMETHEE scores for Liquidity were significantly correlated with the PROMETHEE scores for Government Securities/Total Investments (ρ = 0.957) and Government Securities/Total Assets (ρ = 0.953), which in turn were significantly correlated (ρ = 0.853).

The sample banks also exhibited consistency along the Capital Adequacy dimension. Overall, the best performing banks were: Kotak Mahindra Bank, Tamilnad Mercentile Bank, Federal Bank, HDFC Bank, and Yes Bank, while the worst performing banks were: Central Bank of India, Bank of Rajasthan, United Commercial Bank, Dena Bank, and Syndicate Bank. The overall PROMETHEE scores for Capital Adequacy were significantly correlated with the PROMETHEE scores for Coverage ratio (ρ = 0.910), Capital Adequacy ratio (ρ = 0.840), and with Interest Spread/Total Assets (ρ = 0.814). Further, Coverage ratio was significantly correlated with Interest Spread/Total Assets (ρ = 0.693) and Capital Adequacy ratio (ρ = 0.658), and Interest Spread/Total Assets was significantly correlated with Capital Adequacy ratio (ρ = 0.577).

The sample banks also exhibited mixed performance along the Risk dimension. Overall, the best performing banks were: Tamilnad Mercentile Bank, HDFC Bank, Citi Bank, Indian Bank, and Standard Chartered Bank, while the worst performing banks were: United Commercial Bank, Dena Bank, Central Bank of India, Syndicate Bank, and State Bank of India. The overall PROMETHEE scores for Risk were significantly correlated with the PROMETHEE scores for Beta (ρ = 0.769), Debt/Equity ratio (ρ = 0.700), and Net NPA/Total Advances (ρ = 0.667). Further, Beta was significantly correlated with Net NPA/Total Advances (ρ = 0.346) and Debt/Equity ratio (ρ = 0.333), but Net NPA/Total Advances was not significantly correlated with Debt/Equity ratio (ρ = 0.172).

The sample banks exhibited consistency along the Earnings Performance dimension. Overall, the best performing banks were: Standard Chartered Bank, Indian Bank, Punjab National Bank, Union Bank of India, and Canara Bank, while the worst performing banks were: Development Credit Bank, United Bank, Dhanalakshmi Bank, ING Vysya Bank, and Bank of Rajasthan. The overall PROMETHEE scores for Earnings Performance were significantly correlated with the PROMETHEE scores for Return on Net Worth (ρ = 0.907) and PAT/Total Assets (ρ = 0.611), which in turn were significantly correlated (ρ = 0.292).

Further, there were significant correlations between the PROMETHEE scores of some of the dimensions. The PROMETHEE score for Risk was significantly negatively correlated with those of Management Soundness (ρ = -0.557), Capital Adequacy (ρ = -0.792), and Earnings

Performance (ρ = -0.319), and significantly positively correlated with that of Liquidity (ρ = 0.330); in turn, the PROMETHEE score of Management Soundness was significantly positively correlated with those of Capital Adequacy (ρ = 0.656) and Earnings Performance (ρ = 0.376); and the PROMETHEE score of Capital Adequacy was significantly negatively correlated with that of Liquidity (ρ = -0.454).

The results of the Mann-Whitney tests comparing public sector and private sector banks are presented in Table 9 below.

Table 9. Mann-Whitney tests comparing PROMETHEE scores in public sector and private sector banks

		mean rank	z Stat	p-value
Total Investment/Total Assets	**public sector**	13.9211	-2.5666	0.0103
	private sector	22.8438		
Total Advances/Total Deposits	**public sector**	18.3421	-0.2153	0.8296
	private sector	17.5938		
Business per Employee	**public sector**	19.7632	-1.1095	0.2672
	private sector	15.9063		
Profit per Employee	**public sector**	17.4737	-0.3326	0.7395
	private sector	18.6250		
Management Soundness	**public sector**	16.2895	-1.0763	0.2818
	private sector	20.0313		
Govt Sec/Total Investment	**public sector**	25.1316	-4.4875	0.0000
	private sector	9.5313		
Govt Sec/Total Assets	**public sector**	24.5526	-4.1232	0.0000
	private sector	10.2188		
Liquidity	**public sector**	24.8684	-4.3219	0.0000
	private sector	9.8438		
Coverage ratio	**public sector**	12.2895	-3.5933	0.0003
	private sector	24.7813		
Capital Adequacy ratio	**public sector**	14.0263	-2.5004	0.0124
	private sector	22.7188		
Interest Spread/Total Assets	**public sector**	14.0263	-2.5004	0.0124
	private sector	22.7188		
Capital Adequacy	**public sector**	12.7632	-3.2952	0.0010
	private sector	24.2188		
Debt/Equity ratio	**public sector**	23.5526	-3.4939	0.0005
	private sector	11.4063		
Net NPA/Total Advances	**public sector**	18.5789	-0.3643	0.7156
	private sector	17.3125		
Beta	**public sector**	20.4211	-1.5247	0.1273
	private sector	15.1250		
Risk	**public sector**	22.2895	-2.6991	0.0070
	private sector	12.9063		
Return on Net Worth	**public sector**	21.9737	-2.5004	0.0124
	private sector	13.2813		
PAT/Total Assets	**public sector**	14.8158	-2.0036	0.0451
	private sector	21.7813		
Earnings Performance	**public sector**	19.9211	-1.2088	0.2267
	private sector	15.7188		

There was found to be no significant difference between public sector banks and private sector banks with respect to Management Soundness, and in particular with respect to Total Advances/Total Deposits, Business per Employee, and Profit per Employee; however, there was found to be significant difference between public sector banks and private sector banks with respect to Total Investments/Total Assets, with private sector banks performing significantly better than public sector banks in this regard.

There was found to be significant difference between public sector banks and private sector banks with respect to Liquidity, and in particular with respect to Government Securities/Total Investments and Government Securities/Total Assets, with public sector banks performing significantly better than their private sector counterparts.

There was found to be significant difference between public sector banks and private sector banks with respect to Capital Adequacy, and in particular with respect to Coverage ratio, Capital Adequacy ratio, and Interest Spread/Total Assets, with private sector banks performing significantly better than their public sector counterparts.

There was found to be significant difference between public sector banks and private sector banks with respect to Risk, and in particular with respect to Debt/Equity ratio, with private sector banks performing significantly better than public sector banks; however, there was no significant difference between public sector banks and private sector banks with respect to Net NPA/Total Advances and Beta.

There was found to be no significant difference between public sector banks and private sector banks with respect to Earnings Performance; however, there was found to be significant difference between public sector banks and private sector banks with respect to Return on Net Worth, with public sector banks performing significantly better than private sector banks, and with respect to PAT/Total Assets, with private sector banks performing significantly better than public sector banks.

Discussion

The results of the study raise questions relating to the direct applicability of multi-criteria decision models in bank performance measurement. The factor structure underlying the CAMELS ratios consisted of four distinct dimensions of bank performance which were analogous to the CAMELS components, viz. Management Soundness, Liquidity, Capital Adequacy, and Earnings Performance, as well as a distinct dimension, Risk, comprising Debt/Equity ratio, Net NPA/Total Assets, and Beta, which represent the financial/insolvency risk, credit risk, and market risk aspects, respectively, of banking risk. However, the PROMETHEE scores within these dimensions were not very consistent, particularly within the Management Soundness and Risk dimensions. The ranking of banks along the dimensions also varied considerably.

The comparison of the PROMETHEE scores of public sector and private sector banks along the dimensions was in accordance with the descriptive statistics. The results of the Mann-Whitney tests indicated that private sector banks performed better than public sector banks in terms of Capital Adequacy and Risk, while public sector banks performed better

than private sector banks in terms of Liquidity, while there was no significant difference between public sector and private sector banks in terms of Management Soundness and Earnings Performance. In fact, paradoxically, public sector banks performed significantly better than private sector banks with respect to Return on Net Worth, while private sector banks performed significantly better than public sector banks with respect to PAT/Total Assets.

There were several limitations inherent in the current study. The study only considers a sample of thirty-five banks, over a period of only five years (2007-11), which in particular was adversely affected by the global financial crisis. Thus, the results of the study may be specific to the period considered, and may not be generalisable. Also, the current approach considers only some performance parameters, and fails to consider some qualitative aspects of banking performance, such as management performance and staff efficiency. Further, the study did not analyse the sensitivity of the PROMETHEE scores to the preference thresholds and the parameter weights. Also, the study has used factor analysis, which determines weights in order to maximize the variance explained, but which may not reflect the importance of the variables in banking performance.

There is vast scope for further research in the area of bank performance and risk measurement, particularly due to the dynamic nature of the current banking environment. There are several other multi-criteria models that can be used to analyse banking performance to provide alternative perspectives to regulators and policy makers, for example, ELECTRE methodology may be used to identify banks that may be in distress, VIKOR methodology may be used to identify critical trade-offs in banking performance, and AHP methodology may be used to incorporate qualitative aspects of banking performance.

References

Altman, I. E. (1968). Financial Ratios, Discriminant Analysis and Prediction of Corporate Bankruptcy. *Journal of Finance, 23*(4), 589-609. https://doi.org/10.1111/j.1540-6261.1968.tb00843.x

Avkiran, N. K. (2010). Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. *Omega, 39*(3), 323-334. https://doi.org/10.1016/j.omega.2010.08.001

Babic, Z., Belak, V., & Tomic-Plazibat, N. (1999). Ranking of Croatian Banks according to Business Efficiency. *Proceedings of the Fifth International Symposium on Operations Research*, held at Preddvor, Slovenia.

Barr, R., Killgo, K. A., Siems, T. F., & Zimmel, S. (2002). Evaluating the productive efficiency and performance of U.S. commercial banks. *Managerial Finance, 28*(8), 3-25. https://doi.org/10.1108/03074350210767988

Bayyurt, N. (2013). Ownership Effect on Bank's Performance: Multi Criteria Decision Making Approaches on Foreign and Domestic Turkish Banks. *Procedia - Social and Behavioral Sciences 99*, 919 - 928. https://doi.org/10.1016/j.sbspro.2013.10.565

Beaver, W. (1966). Financial Ratios as Predictors of Failure. *Journal of Accounting Research, 5,* 71-111. https://doi.org/10.2307/2490171

Beaver, W. (1968). Market Prices, Financial Ratios and Prediction of Failure. *Journal of Accounting Research, 6*(2), 179-192. https://doi.org/10.2307/2490233

Bhattacharyay, B.N. (2011). Macro-prudential Monitoring of Financial Crisis: An Empirical Framework. in Chatterji, M., Gopal, D., and Singh, S. (eds.) *Governance, Development and Conflict (Contributions to Conflict Management, Peace Economics and Development, Volume 18)*, Emerald Group Publishing Limited, 71-121.

Cetin, M.K., & Cetin, E.I. (2010). Multi-Criteria Analysis of Banks' Performances. *International Journal of Economics and Finance Studies*, *2*(2), 73-78.

Dash, M., & Charles, C. (2012). An Analysis of the Technical Efficiency of Banks in India. *IUP Journal of Bank Management, 11*(4), 100-109.

Dash, M., & Das, A. (2013). Performance Appraisal of Indian Banks Using CAMELS Rating. *IUP Journal of Bank Management, 12*(2), 31-42.

Dash, M., & Vegesna, S. (2014). Efficiency of Public and Private Sector Banks in India. Journal of Applied Management and Investments 3(3), 183-187.

Doumpos, M., & Zopounidis, C. (2011). A Multicriteria Approach to Bank Rating. in *Evaluation and Decision Models with Multiple Criteria: Case Studies*, eds. Bisdorf, R., Dias, L.C., Meyer, P., Mousseau, V., and Pirot, M., from International Handbooks on Information Systems, Springer

Doumpos, M., & Zopounidis, C. (2013). Efficiency and performance evaluation of European cooperative banks. in *Efficiency and Productivity Growth: Modelling in the Financial Services Industry*, ed. Pasiouras, F., John Wiley & Sons, Ltd, Chichester, UK.

Fallah, M., Aryanezhadb, M.B., Najafi, S.E., & Shahsavaripour, N. (2011). An empirical study on measuring the relative efficiency using DEA method: A case study of bank industry. *Management Science Letters, 1*(1), 49-56. https://doi.org/10.5267/j.msl.2010.01.005

Ginevičius, R. and Podviezko, A. (2013). The Evaluation of Financial Stability and Soundness of Lithuanian Banks. *Ekonomska Istraživanja-Economic Research* 26(2), 191-208. https://doi.org/10.1080/1331677X.2013.11517616

Halkos, G. and Salamouris, D. (2004). Efficiency measurement of Greek commercial banks with the use of financial ratios: A Data Envelopment Analysis approach. *Management Account Research* 15, 201-224. https://doi.org/10.1016/j.mar.2004.02.001

Ho, C.-T. (2006). Measuring bank operations performance: An approach based on grey relation analysis. *Journal of the Operational Research Society, 57*(4), 337-349. https://doi.org/10.1057/palgrave.jors.2601985

Hsiao, S.-H. (2008). Financial Risk Management of Life Insurers by CAMEL-S Rating. *Journal of Global Business Management* 4(1).

Hsiao, S.-H. (2006). A Study of Investment Performance and Overall Financial Performance for Life Insurers in Taiwan. Working Paper, Rutgers, available at: http://centerforpbbefr.rutgers.edu/2006/Paper%202006/03AS-077-Shu-Hua%20Hsiao.pdf.

Hunjak, T., & Jacovceviv, D. (2001). AHP-Based Model for Bank Performance Evaluation and Rating. *Proceedings of the Sixth ISAHP*, held at Berne, Switzerland.

Ioannidis, C., Pasiouras, F., & Zopounidis, C. (2010). Assessing bank soundness with classification techniques. *Omega, 38*(5), 345-357. https://doi.org/10.1016/j.omega.2009.10.009

Kao, C., & Liu, S.-T. (2004). Predicting bank performance with financial forecasts: A case of Taiwan commercial banks. *Journal of Banking and Finance, 28*(10), 2353-2368. https://doi.org/10.1016/j.jbankfin.2003.09.008

Klomp, J., & de Haan, J. (2011). Banking risk and regulation: Does one size fit all?" DNB Working Paper No.323, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=197723.

Kosmidou, K., & Zopounidis, C. (2008). Measurement of bank performance in Greece. *South-Eastern Europe Journal of Economics, 6*(1), 79-95.

Maliszewski, K. (2009). Measuring Stability of the Polish Financial System by means of a Synthetic Index. *Presented at the 12th International Conference on Finance and Banking,* held on Oct. 28-29, 2009, organised by Silesian University in Opava.

Maishanu, M.M. (2004). A Univariate Approach to Predicting failure in the Commercial Banking Sub-Sector. *Nigerian Journal of Accounting Research*, *1*(1).

Mareschal, B., & Brans, J. (1991). BANKADVISER: An industrial evaluation system. *European Journal of Operational Research, 54*, 318-324. https://doi.org/10.1016/0377-2217(91)90106-6

Mareschal, B., & Mertens, D. (1992). BANKS: A multicriteria decision support system for financial evaluation in the international banking sector. *Journal of Decision Systems, 1*(2/3), 175-189. https://doi.org/10.1080/12460125.1992.10511524

Minh, N.K., Long, G.T., & Hung, N.V. (2013). Efficiency and Super-Efficiency of Commercial Banks in Vietnam: Performances and Determinants. *Asia-Pacific Journal of Operational Research, 30*(1), 1-19. https://doi.org/10.1142/S0217595912500479

Mous, L. (2005). Predicting bankruptcy with discriminant analysis and decision tree using financial ratios. *Working Paper Series, University of Rotterdam*.

Njoku, J. (2011). Anatomic assessment of CAMEL in Nigerian banking. *International Journal of Economics and Accounting, 2*(1), 76-99. https://doi.org/10.1504/IJEA.2011.038964

Njoku, J., & Inanga, E.L. (2012). Underlying nature of the 2008-2009 banking crises. *African Journal of Accounting, Auditing and Finance, 1*(2), 190-208. https://doi.org/10.1504/AJAAF.2012.048070

Önder, E., & Hepşen, A. (2013). Combining Time Series Analysis and Multi Criteria Decision Making Techniques for Forecasting Financial Performance of Banks in Turkey. *Proceedings of the International Conference on Applied Business and Economics (ICABE-13)* held at New York, USA.

Parkan, C., & Liu, M.-L. (1999). Measurement of the performance of an investment bank using the operational competitiveness rating procedure. *Omega, 27*(2), 201-217. https://doi.org/10.1016/S0305-0483(98)00041-3

Popovska, J. (2014). Modelling Financial Stability: The Case of the Banking Sector in Macedonia. *Journal of Applied Economics and Business, 2*(1), 68-91.

Raveh, A. (2000). The Greek banking system: Reanalysis of performance. *European Journal of Operational Research, 120*(3), 525-534. https://doi.org/10.1016/S0377-2217(98)00384-1

Rezaei, F., & Gheibdoust, H. (2014). Performance evaluation of Banking Industry in Iran by VIKOR Method. *International Journal of Management & Humanity Sciences, 3*(7), 2653-2662.

Rosenzweig, V.V., Volarević, H., & Varović, M. (2013). A multi-criteria analysis of the banking system in the Republic of Croatia. *Financial Theory and Practice, 37*(4), 403-422. https://doi.org/10.3326/fintp.37.4.4

Sahajwala, R., & van der Bergh, P. (2000). Supervisory Risk Assessment and Early Warning Systems. *Basel Committee on Banking Supervision Working Papers, No. 4, Bank of International Settlements*.

Seçme, N.Y, Bayrakdaroglu, A., & Kahraman, C. (2009). Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS. *Expert Systems with Applications, 36*, 11699-11709. https://doi.org/10.1016/j.eswa.2009.03.013

Spathis, C., Kosmidou, K., & Doumpos, M. (2002). Assessing profitability factors in the greek banking system: A multicriteria approach. *International Transactions in Operational Research, 9*, 517-530. https://doi.org/10.1111/1475-3995.00371

Stankevičienė, J., & Mencaitė, E. (2012). The evaluation of bank performance using a multi-criteria decision making model: a case study on Lithuanian commercial banks. *Technological & Economic Development of Economy, 18*(1), 189-205. https://doi.org/10.3846/20294913.2012.668373

Wua, H.-Y., Tzeng, G.-H., & Chen, Y.-H. (2009). A fuzzy MCDM approach for evaluating banking performance based on Balanced Scorecard. *Expert Systems with Applications, 36*, 10135-10147. https://doi.org/10.1016/j.eswa.2009.01.005

Yakob, R., Yusop, Z., Radam, A., & Ismail, N. (2012). CAMEL Rating Approach to Assess the Insurance Operators Financial Strength. Jurnal Ekonomi Malaysia, *46*(2), 3-15.

Zopounidis, C., Despotis, D., & Stavropoulou, E. (1995). Multiattribute evaluation of Greek banking performance. *Applied Stochastic Models and Data Analysis, 11*(1), 97-107. https://doi.org/10.1002/asm.3150110110

Table 4. PROMETHEE Scores for Management Soundness

	Total Investment/Total Assets			Total Advances/Total Deposits			Business per Employee			Profit per Employee			
	φ+	φ-	φ	φ+	φ-	φ	φ+	φ-	φ	φ+	φ-	φ	Φ
Allahabad Bank	0.4602	0.2199	0.2403	0.1414	0.2955	-0.1541	0.2799	0.2679	0.0120	0.2071	0.2401	-0.0330	0.0176
Andhra Bank	0.0754	0.6570	-0.5816	0.2846	0.1891	0.0955	0.3820	0.2321	0.1499	0.2776	0.1908	0.0868	-0.0618
Axis Bank	0.7443	0.0726	0.6718	0.1659	0.2684	-0.1025	0.8103	0.0571	0.7532	0.8458	0.0681	0.7776	0.5328
Bank of Baroda	0.0294	0.9156	-0.8862	0.2644	0.1972	0.0672	0.5535	0.1697	0.3838	0.3691	0.1641	0.2050	-0.0548
Bank of India	0.0411	0.8077	-0.7666	0.3659	0.1694	0.1965	0.4812	0.1943	0.2869	0.1858	0.2587	-0.0729	-0.0889
Bank of Rajasthan	0.9276	0.0057	0.9219	0.0000	0.9998	-0.9998	0.0294	0.6062	-0.5769	0.0180	0.7327	-0.7147	-0.3396
Canara Bank	0.1292	0.4939	-0.3646	0.2445	0.2093	0.0351	0.4356	0.2110	0.2246	0.2776	0.1908	0.0868	-0.0031
Central Bank of India	0.2300	0.3710	-0.1411	0.0643	0.4820	-0.4177	0.0630	0.5068	-0.4438	0.0366	0.5958	-0.5592	-0.3912
Citi Bank	0.0417	0.8039	-0.7622	0.8865	0.0616	0.8249	0.9375	0.0294	0.9080	0.9706	0.0294	0.9412	0.4794
Corporation Bank	0.3749	0.2758	0.0991	0.1671	0.2673	-0.1002	0.7696	0.0780	0.6915	0.6319	0.1081	0.5238	0.3103
Dena Bank	0.1814	0.4175	-0.2360	0.1006	0.3711	-0.2705	0.2519	0.2818	-0.0298	0.1166	0.3442	-0.2276	-0.1894
Development Credit Bank	0.6510	0.1174	0.5337	0.1396	0.2981	-0.1585	0.0038	0.7105	-0.7067	0.0000	0.9614	-0.9614	-0.3293
Dhanlaxmi Bank	0.1084	0.5573	-0.4489	0.0433	0.5940	-0.5507	0.0101	0.6779	-0.6678	0.0220	0.6867	-0.6648	-0.5841
Federal Bank	0.4958	0.2001	0.2957	0.2840	0.1893	0.0946	0.2696	0.2725	-0.0029	0.2776	0.1908	0.0868	0.1179
HDFC Bank	0.6605	0.1130	0.5475	0.1989	0.2415	-0.0427	0.0615	0.5102	-0.4487	0.2523	0.2055	0.0469	0.0233
ICICI Bank	0.1276	0.4976	-0.3700	0.8724	0.0725	0.7998	0.7301	0.0982	0.6320	0.7232	0.0868	0.6364	0.4234
IDBI Bank	0.2158	0.0000	0.2158	0.9893	0.0000	0.9893	1.0000	0.0000	1.0000	0.7232	0.0000	0.7232	0.7316
Indian Bank	0.6039	0.1419	0.4620	0.0975	0.3778	-0.2802	0.1253	0.3964	-0.2711	0.3691	0.1641	0.2050	0.0302
ING Vysya Bank	0.2984	0.3223	-0.0239	0.3622	0.1701	0.1921	0.0841	0.4665	-0.3824	0.0740	0.4481	-0.3741	-0.1523
Indian Overseas Bank	0.2585	0.3488	-0.0903	0.3203	0.1796	0.1407	0.1945	0.3171	-0.1226	0.1166	0.3442	-0.2276	-0.0776
J &K Bank	0.6250	0.1299	0.4951	0.0336	0.6708	-0.6372	0.1475	0.3644	-0.2169	0.2776	0.1908	0.0868	-0.0637
Karnataka Bank	0.9562	0.0000	0.9562	0.0292	0.7197	-0.6904	0.1458	0.3667	-0.2209	0.1166	0.3442	-0.2276	-0.0419
Kotak Mahindra	0.8448	0.0314	0.8134	0.9706	0.0187	0.9519	0.0003	0.7467	-0.7465	0.1858	0.2587	-0.0729	0.2229
Oriental Bank of Commerce	0.1723	0.4280	-0.2557	0.1462	0.2895	-0.1433	0.7947	0.0637	0.7310	0.4304	0.1508	0.2796	0.1597
Punjab National Bank	0.1256	0.5032	-0.3776	0.3690	0.1690	0.2000	0.1777	0.3319	-0.1542	0.2523	0.2055	0.0469	-0.0737
South Indian Bank	0.2122	0.3852	-0.1730	0.0854	0.4080	-0.3226	0.1905	0.3201	-0.1296	0.1166	0.3442	-0.2276	-0.2118
Standard Chartered	0.0000	1.0000	-1.0000	0.8933	0.0588	0.8345	0.7316	0.0975	0.6340	1.0000	0.0000	1.0000	0.3671
State Bank of India	0.1444	0.4654	-0.3210	0.6532	0.1390	0.5143	0.0496	0.5427	-0.4931	0.0926	0.3947	-0.3021	-0.1589
Syndicate Bank	0.0595	0.7169	-0.6574	0.2689	0.1951	0.0738	0.1922	0.3188	-0.1266	0.0740	0.4481	-0.3741	-0.2734
Tamilnad Mercentile Bank	0.8131	0.0426	0.7705	0.0823	0.4175	-0.3353	0.0051	0.7012	-0.6960	0.1858	0.2587	-0.0729	-0.0852
UCO Bank	0.2167	0.3812	-0.1645	0.1355	0.3047	-0.1693	0.2784	0.2685	0.0099	0.0433	0.5652	-0.5220	-0.2114
Union Bank of India	0.1487	0.4587	-0.3100	0.2655	0.1966	0.0689	0.2822	0.2671	0.0151	0.2776	0.1908	0.0868	-0.0350
United Bank	0.7623	0.0631	0.6992	0.0297	0.7130	-0.6833	0.0000	0.7527	-0.7527	0.0260	0.6572	-0.6312	-0.3428
Vijiya Bank	0.4664	0.2165	0.2499	0.0579	0.5102	-0.4523	0.2362	0.2914	-0.0552	0.0926	0.3947	-0.3021	-0.1373
YES Bank	0.5264	0.1857	0.3407	0.5787	0.1474	0.4313	0.8558	0.0434	0.8123	0.8941	0.0588	0.8352	0.6085

Table 5. PROMETHEE Scores for Liquidity

	Govt Sec/Total Investment			Govt Sec/Total Assets			
	φ+	φ-	φ	φ+	φ-	φ	Φ
Allahabad Bank	0.6316	0.0258	0.6057	0.8057	0.0000	0.8057	0.7049
Andhra Bank	0.6946	0.0074	0.6872	0.5894	0.0371	0.5523	0.6203
Axis Bank	0.0000	0.8242	-0.8242	0.0142	0.7516	-0.7374	-0.7812
Bank of Baroda	0.6550	0.0143	0.6407	0.4770	0.3005	0.1765	0.4105
Bank of India	0.7953	0.0000	0.7953	0.5635	0.0727	0.4908	0.6443
Bank of Rajasthan	0.0158	0.7178	-0.7020	0.1479	0.5561	-0.4083	-0.5564
Canara Bank	0.5909	0.0619	0.5290	0.5556	0.0862	0.4693	0.4994
Central Bank of India	0.6029	0.0456	0.5573	0.6295	0.0140	0.6154	0.5861
Citi Bank	0.3124	0.4764	-0.1640	0.0953	0.5994	-0.5040	-0.3326
Corporation Bank	0.6000	0.0485	0.5515	0.6558	0.0097	0.6461	0.5984
Dena Bank	0.5973	0.0519	0.5454	0.5932	0.0328	0.5604	0.5528
Development Credit Bank	0.0867	0.6117	-0.5250	0.1591	0.5496	-0.3905	-0.4583
Dhanlaxmi Bank	0.2247	0.5192	-0.2945	0.1071	0.5872	-0.4801	-0.3865
Federal Bank	0.0625	0.6392	-0.5767	0.0801	0.6184	-0.5383	-0.5577
HDFC Bank	0.0985	0.6018	-0.5032	0.1714	0.5444	-0.3729	-0.4386
ICICI Bank	0.0609	0.6415	-0.5806	0.0159	0.7408	-0.7250	-0.6522
IDBI Bank	0.6520	0.0000	0.6520	0.6085	0.0000	0.6085	0.6304
Indian Bank	0.4917	0.2664	0.2253	0.5991	0.0274	0.5716	0.3970
ING Vysya Bank	0.1475	0.5677	-0.4203	0.1207	0.5752	-0.4545	-0.4372
Indian Overseas Bank	0.5874	0.0684	0.5189	0.6142	0.0187	0.5954	0.5569
J &K Bank	0.0140	0.7223	-0.7084	0.0276	0.7055	-0.6778	-0.6932
Karnataka Bank	0.0149	0.7197	-0.7048	0.1634	0.5474	-0.3840	-0.5458
Kotak Mahindra	0.1773	0.5479	-0.3705	0.4010	0.4313	-0.0304	-0.2019
Oriental Bank of Commerce	0.6734	0.0103	0.6631	0.6396	0.0119	0.6277	0.6456
Punjab National Bank	0.6481	0.0168	0.6313	0.6076	0.0216	0.5860	0.6088
South Indian Bank	0.0889	0.6094	-0.5205	0.0483	0.6608	-0.6125	-0.5661
Standard Chartered	0.2241	0.5195	-0.2954	0.0000	0.9253	-0.9253	-0.6077
State Bank of India	0.4439	0.3516	0.0922	0.4043	0.4279	-0.0235	0.0349
Syndicate Bank	0.4152	0.3990	0.0162	0.2753	0.5106	-0.2353	-0.1085
Tamilnad Mercentile Bank	0.0038	0.7742	-0.7704	0.0467	0.6635	-0.6168	-0.6943
UCO Bank	0.6118	0.0385	0.5733	0.5995	0.0271	0.5723	0.5728
Union Bank of India	0.5398	0.1674	0.3724	0.5104	0.1889	0.3214	0.3471
United Bank	0.3725	0.4400	-0.0675	0.5240	0.1546	0.3694	0.1491
Vijiya Bank	0.4550	0.3319	0.1232	0.5038	0.2085	0.2954	0.2086
YES Bank	0.0083	0.7449	-0.7366	0.0155	0.7423	-0.7268	-0.7317

Table 6. PROMETHEE Scores for Capital Adequacy

	Coverage ratio			CAR			Interest Spread/Total Assets			
	ϕ+	ϕ-	ϕ	ϕ+	ϕ-	ϕ	ϕ+	ϕ-	ϕ	Φ
Allahabad Bank	0.1788	0.4429	-0.2641	0.3434	0.2156	0.1278	0.1866	0.2799	-0.0934	-0.0674
Andhra Bank	0.3162	0.2950	0.0212	0.2211	0.2862	-0.0650	0.3966	0.2109	0.1857	0.0340
Axis Bank	0.6048	0.1621	0.4427	0.5370	0.1455	0.3915	0.9107	0.0280	0.8826	0.5454
Bank of Baroda	0.3375	0.2800	0.0576	0.2993	0.2377	0.0616	0.2449	0.2510	-0.0061	0.0414
Bank of India	0.1202	0.5225	-0.4024	0.1690	0.3363	-0.1673	0.3302	0.2273	0.1029	-0.1725
Bank of Rajasthan	0.0304	0.7308	-0.7004	0.0019	0.7780	-0.7761	0.0038	0.6674	-0.6635	-0.7190
Canara Bank	0.1234	0.5184	-0.3951	0.6732	0.1304	0.5428	0.0425	0.4376	-0.3951	-0.0378
Central Bank of India	0.0031	0.8909	-0.8878	0.0000	0.8100	-0.8100	0.0195	0.5102	-0.4907	-0.7479
Citi Bank	0.8402	0.0653	0.7749	0.0157	0.6820	-0.6663	0.9000	0.0331	0.8669	0.2514
Corporation Bank	0.3486	0.2733	0.0753	0.4704	0.1599	0.3105	0.0467	0.4292	-0.3825	0.0377
Dena Bank	0.0514	0.6643	-0.6129	0.0122	0.6973	-0.6851	0.1381	0.3144	-0.1763	-0.5191
Development Credit Bank	0.5699	0.1718	0.3981	0.4533	0.1656	0.2877	0.0819	0.3771	-0.2953	0.1634
Dhanlaxmi Bank	0.2277	0.3776	-0.1500	0.0387	0.6015	-0.5628	0.1865	0.2800	-0.0934	-0.2915
Federal Bank	0.8828	0.0238	0.8590	0.9571	0.0002	0.9569	0.6720	0.1576	0.5144	0.8006
HDFC Bank	0.7941	0.0924	0.7016	0.8236	0.1055	0.7181	0.9001	0.0329	0.8672	0.7539
ICICI Bank	0.5075	0.1953	0.3121	0.0788	0.4938	-0.4150	0.0156	0.5319	-0.5163	-0.1950
IDBI Bank	0.1161	0.0000	0.1161	0.1212	0.0000	0.1212	0.1408	0.3122	-0.1715	0.0381
Indian Bank	0.4517	0.2214	0.2302	0.3960	0.1891	0.2070	0.6134	0.1682	0.4452	0.2811
ING Vysya Bank	0.2757	0.3279	-0.0522	0.1354	0.3789	-0.2436	0.0321	0.4613	-0.4292	-0.2298
Indian Overseas Bank	0.1011	0.5574	-0.4563	0.4138	0.1812	0.2326	0.0714	0.3911	-0.3198	-0.1559
J &K Bank	0.5184	0.1900	0.3284	0.5482	0.1438	0.4044	0.2545	0.2477	0.0068	0.2680
Karnataka Bank	0.5189	0.1898	0.3291	0.1897	0.3127	-0.1230	0.0000	0.7528	-0.7528	-0.1437
Kotak Mahindra	0.9593	0.0000	0.9593	0.9574	0.0000	0.9574	0.9986	0.0000	0.9986	0.9695
Oriental Bank of Commerce	0.3750	0.2590	0.1161	0.1166	0.4077	-0.2911	0.1293	0.3226	-0.1932	-0.1250
Punjab National Bank	0.2651	0.3378	-0.0727	0.2479	0.2673	-0.0194	0.4710	0.1948	0.2762	0.0445
South Indian Bank	0.3124	0.2978	0.0146	0.4866	0.1556	0.3310	0.2221	0.2612	-0.0392	0.1202
Standard Chartered	0.8769	0.0288	0.8481	0.2095	0.2951	-0.0856	0.5858	0.1730	0.4128	0.3715
State Bank of India	0.2296	0.3753	-0.1457	0.1917	0.3107	-0.1191	0.0496	0.4243	-0.3748	-0.1992
Syndicate Bank	0.0340	0.7139	-0.6799	0.0393	0.5997	-0.5605	0.1131	0.3400	-0.2269	-0.5086
Tamilnad Mercentile Bank	0.9073	0.0115	0.8957	0.9283	0.0319	0.8964	0.8088	0.1298	0.6790	0.8358
UCO Bank	0.0000	0.9205	-0.9205	0.0082	0.7215	-0.7134	0.0316	0.4626	-0.4309	-0.7056
Union Bank of India	0.1132	0.5335	-0.4204	0.2598	0.2597	0.0001	0.2484	0.2497	-0.0013	-0.1438
United Bank	0.0354	0.7089	-0.6735	0.0859	0.4759	-0.3901	0.0279	0.4751	-0.4472	-0.5027
Vijiya Bank	0.0461	0.6776	-0.6315	0.1208	0.3996	-0.2788	0.0158	0.5303	-0.5145	-0.4646
YES Bank	0.6631	0.1493	0.5138	0.8996	0.0754	0.8242	0.8617	0.0860	0.7758	0.7048

Table 7. PROMETHEE Scores for Risk

	Debt/Equity ratio			Net NPA/Total Advances			Beta			
	φ+	φ-	φ	φ+	φ-	φ	φ+	φ-	φ	Φ
Allahabad Bank	0.3280	0.2673	0.0607	0.2509	0.3843	-0.1334	0.4005	0.1408	0.2597	0.0620
Andhra Bank	0.4194	0.1894	0.2300	0.0068	0.8541	-0.8473	0.2671	0.2826	-0.0156	-0.2219
Axis Bank	0.1997	0.4965	-0.2968	0.0569	0.7037	-0.6467	0.6509	0.0227	0.6282	-0.1018
Bank of Baroda	0.3653	0.2243	0.1410	0.0428	0.7237	-0.6809	0.1847	0.4673	-0.2826	-0.2841
Bank of India	0.5929	0.1051	0.4878	0.2642	0.3691	-0.1048	0.3802	0.1576	0.2225	0.1949
Bank of Rajasthan	0.6186	0.0982	0.5203	0.2142	0.4425	-0.2283	0.0000	0.9115	-0.9115	-0.2227
Canara Bank	0.3686	0.2213	0.1474	0.3940	0.2419	0.1521	0.2971	0.2415	0.0556	0.1178
Central Bank of India	0.9026	0.0350	0.8676	0.5213	0.1830	0.3382	0.4396	0.1096	0.3300	0.5037
Citi Bank	0.0224	0.8368	-0.8144	0.4046	0.2359	0.1688	0.0000	0.9115	-0.9115	-0.5112
Corporation Bank	0.3862	0.2093	0.1770	0.0310	0.7562	-0.7252	0.1306	0.7519	-0.6213	-0.4031
Dena Bank	0.7843	0.0649	0.7194	0.6577	0.1331	0.5246	0.6626	0.0201	0.6425	0.6266
Development Credit Bank	0.0863	0.7202	-0.6340	0.9793	0.0000	0.9793	0.7844	0.0026	0.7818	0.3993
Dhanlaxmi Bank	0.5542	0.1187	0.4354	0.3365	0.2880	0.0485	0.4948	0.0772	0.4176	0.2970
Federal Bank	0.0402	0.8003	-0.7601	0.0413	0.7262	-0.6849	0.2528	0.3047	-0.0519	-0.4935
HDFC Bank	0.0814	0.7267	-0.6454	0.0401	0.7290	-0.6889	0.1821	0.4796	-0.2975	-0.5420
ICICI Bank	0.2120	0.4761	-0.2641	0.8213	0.0564	0.7650	0.7208	0.0104	0.7104	0.4193
IDBI Bank	0.3685	0.0000	0.3685	0.4634	0.0000	0.4634	0.5194	0.0668	0.4526	0.4296
Indian Bank	0.1331	0.6484	-0.5153	0.0189	0.7991	-0.7802	0.1990	0.4204	-0.2214	-0.5059
ING Vysya Bank	0.3142	0.2925	0.0217	0.3097	0.3183	-0.0086	0.1475	0.6353	-0.4879	-0.1620
Indian Overseas Bank	0.5481	0.1218	0.4263	0.6087	0.1518	0.4569	0.2281	0.3503	-0.1222	0.2502
J &K Bank	0.1902	0.5149	-0.3247	0.2537	0.3807	-0.1271	0.1168	0.8506	-0.7338	-0.3962
Karnataka Bank	0.1704	0.5556	-0.3852	0.5935	0.1574	0.4361	0.3315	0.2030	0.1285	0.0704
Kotak Mahindra	0.0000	0.8969	-0.8969	0.8824	0.0208	0.8616	0.3224	0.2123	0.1101	0.0470
Oriental Bank of Commerce	0.2329	0.4411	-0.2081	0.2433	0.3956	-0.1523	0.2893	0.2515	0.0379	-0.1054
Punjab National Bank	0.3209	0.2792	0.0416	0.1282	0.5899	-0.4617	0.1912	0.4437	-0.2526	-0.2306
South Indian Bank	0.3375	0.2541	0.0834	0.1453	0.5594	-0.4141	0.1494	0.6254	-0.4760	-0.2770
Standard Chartered	0.0011	0.8894	-0.8883	0.4797	0.1997	0.2800	0.0000	0.9115	-0.9115	-0.4966
State Bank of India	0.3394	0.2519	0.0875	0.8742	0.0238	0.8504	0.4396	0.1096	0.3300	0.4309
Syndicate Bank	0.9406	0.0179	0.9227	0.3223	0.3032	0.0191	0.5815	0.0441	0.5374	0.4826
Tamilnad Mercentile Bank	0.0078	0.8694	-0.8616	0.3711	0.2565	0.1147	0.0000	0.9115	-0.9115	-0.5447
UCO Bank	0.9856	0.0000	0.9856	0.8618	0.0302	0.8316	0.8231	0.0000	0.8231	0.8776
Union Bank of India	0.4983	0.1474	0.3509	0.1839	0.4931	-0.3091	0.2398	0.3270	-0.0871	-0.0238
United Bank	0.5610	0.1158	0.4451	0.7835	0.0770	0.7065	0.2126	0.3858	-0.1732	0.3242
Vijiya Bank	0.6964	0.0819	0.6145	0.3711	0.2565	0.1147	0.4948	0.0772	0.4176	0.3766
YES Bank	0.1610	0.5792	-0.4182	0.0000	0.9105	-0.9105	0.6163	0.0324	0.5839	-0.2457

Table 8. PROMETHEE Scores for Earnings Performance

	Return on Net Worth			PAT/Total Assets			
	φ+	φ-	φ	φ+	φ-	φ	Φ
Allahabad Bank	0.5930	0.0826	0.5104	0.3515	0.2074	0.1441	0.3631
Andhra Bank	0.5495	0.1151	0.4344	0.4393	0.1473	0.2920	0.3771
Axis Bank	0.4503	0.2177	0.2325	0.5446	0.0902	0.4544	0.3218
Bank of Baroda	0.3779	0.2970	0.0809	0.3125	0.2473	0.0652	0.0746
Bank of India	0.6319	0.0599	0.5720	0.2782	0.2872	-0.0090	0.3383
Bank of Rajasthan	0.1024	0.5979	-0.4956	0.0294	0.8033	-0.7739	-0.6075
Canara Bank	0.6943	0.0329	0.6615	0.3514	0.2075	0.1439	0.4532
Central Bank of India	0.4440	0.2248	0.2192	0.0394	0.7462	-0.7068	-0.1534
Citi Bank	0.3156	0.3643	-0.0487	0.7650	0.0451	0.7199	0.2605
Corporation Bank	0.4571	0.2109	0.2462	0.3889	0.1817	0.2071	0.2305
Dena Bank	0.6653	0.0448	0.6205	0.2174	0.3822	-0.1648	0.3045
Development Credit Bank	0.0000	1.0000	-1.0000	0.0000	1.0000	-1.0000	-1.0000
Dhanlaxmi Bank	0.0319	0.7548	-0.7229	0.0448	0.7233	-0.6785	-0.7051
Federal Bank	0.1002	0.6013	-0.5011	0.5159	0.1011	0.4148	-0.1326
HDFC Bank	0.3210	0.3579	-0.0369	0.6797	0.0609	0.6188	0.2269
ICICI Bank	0.0820	0.6377	-0.5558	0.2638	0.3064	-0.0425	-0.3493
IDBI Bank	0.0392	0.0000	0.0392	0.0511	0.0000	0.0511	0.0440
Indian Bank	0.8395	0.0000	0.8395	0.8397	0.0330	0.8067	0.8263
ING Vysya Bank	0.0323	0.7535	-0.7213	0.0890	0.6177	-0.5287	-0.6438
Indian Overseas Bank	0.6106	0.0714	0.5391	0.2875	0.2760	0.0115	0.3269
J &K Bank	0.2959	0.3899	-0.0940	0.4708	0.1263	0.3445	0.0824
Karnataka Bank	0.1160	0.5808	-0.4648	0.3101	0.2500	0.0601	-0.2536
Kotak Mahindra	0.0311	0.7593	-0.7282	0.5266	0.0965	0.4301	-0.2622
Oriental Bank of Commerce	0.1089	0.5891	-0.4802	0.1496	0.5078	-0.3582	-0.4311
Punjab National Bank	0.7171	0.0259	0.6912	0.5035	0.1072	0.3962	0.5725
South Indian Bank	0.2421	0.4509	-0.2088	0.2497	0.3283	-0.0786	-0.1564
Standard Chartered	0.8383	0.0001	0.8382	1.0000	0.0000	1.0000	0.9033
State Bank of India	0.1835	0.5057	-0.3222	0.2217	0.3751	-0.1534	-0.2543
Syndicate Bank	0.5567	0.1086	0.4481	0.1284	0.5446	-0.4162	0.1004
Tamilnad Mercentile Bank	0.1586	0.5306	-0.3720	0.8766	0.0294	0.8472	0.1185
UCO Bank	0.5528	0.1119	0.4409	0.0450	0.7225	-0.6775	-0.0091
Union Bank of India	0.7964	0.0078	0.7886	0.3420	0.2161	0.1259	0.5220
United Bank	0.0294	0.7804	-0.7510	0.0298	0.7989	-0.7691	-0.7583
Vijiya Bank	0.2667	0.4260	-0.1593	0.0900	0.6156	-0.5256	-0.3067
YES Bank	0.4335	0.2372	0.1962	0.5465	0.0896	0.4569	0.3011