

## Estimating the Firm's Credit Capacity: State Bank of India

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### ABSTRACT

*In times of economic and financial stresses the need for effective failure prediction model to act as an early warning system for the corporate has always been looked upon. Credit decisions by commercial banks are based to a large extent on the financial statements provided by corporate borrowers as monitored using financial ratios suggesting their financial position. Credit decisions by commercial banks are based to a large extent on the financial statements provided by corporate borrowers as monitored using financial ratios specified in loan covenants. This paper examines the standard ratios used to measure the financial condition of a firm. The paper first surveys the existing literature for various techniques that have been developed to assess credit risks including the credit scoring models and quantitative models pioneered by Beaver and Altman which focuses on the borrower's inability to meet credit obligation. Thereafter, this paper using the tailored back-propagation neural network endeavors to predict the financial ratios expressing the position of a firm to regulate the bankruptcy and assess the credit risks. It first estimates the financial ratio for a firm from 2001-2008 to the train the BPNN and uses the estimates of the year 2009 and 2010 values for the validation process. Finally it dwells to draw predictions for the period 2011-2015 and emphasizes the growing role of BPNN application based prediction models for banking sector with a case study of State Bank of India. We conclude with practical suggestions on how best to integrate models and research into policy making decisions.*

**Keywords:** Financial Ratio, Credit Analysis, Capital Market, Credit Risk

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## 1. INTRODUCTION

Credit analysis is a key component of modern finance. It is used in both the capital markets, evaluating bond investments and the banking markets, evaluating credit applications. Throughout the years many techniques have been developed to assess credit risks. These include credit scoring models often built around the 5Cs of credit (character, capacity, collateral, conditions and capital) and quantitative models pioneered by Beaver and Altman that focus on a borrower's probability of default (or inability to meet credit obligations). Economists see two aspects in the economic crisis, once creditors panic and begin to pull out their holdings; the underlying health of banks — or entire countries — no longer matters a great deal. In a global financial system, national borders are porous. Moving further the year 2008, one of the worst years in the world's economic history, experienced a major global meltdown. This global meltdown led to job layoffs all across the world. These recent global economic crisis have been devastating due to the absence of effective early warning systems. The need of an effective failure prediction model to act as an alarm for the corporate is the basic need of any economic system. The model has to be robust over time. This study analyses the ratios and uses tailored neural network model to predict the financial ratios. The prediction of the financial ratios would convey the position of the firm to regulate the bankruptcy. The stability of the banking sector is of major importance for economic outcomes. Banks form the backbone of modern economies and instability in the banking sector can pose problems to the economic system as a whole. Credit losses, or more generally, asset quality problems, have repeatedly been identified as a key trigger of bank failures, e.g. Graham and Horner (1988), Caprio and Klingebiel (1996). Accordingly, much research effort has gone into developing methods for assessing credit risk both at a systemic and bank-specific level. Two major components determine the extent of a credit loss suffered: first, the probability of a default (PD) and, second, the loss given default (LGD), which equals one minus the recovery rate in the event of default. Most credit risk literature has focussed on estimating PD.

Finance, accounting and banking programs across the globe typically include a significant amount of credit risk assessment, usually in conjunction with the evaluation of financial statements. Likewise, there has been a continual development and refinement of credit and default assessment models in both the academic and practitioner worlds. Based on the evidences

and circumstantial evaluation of financial institutes it is rational enough to conclude that the institutes from times immemorial have been engaged in risk modeling since the time they have been incorporated. From centuries the financial institutes like banks have operated on intuitive models that are based on personal judgement and experience.

The paper studies the application of neural network in forecasting financial ratios. The financial ratios have been divided into pillars. The paper is an attempt to forecast the ratios so as to communicate the financial position of the firm by forecasting the financial ratios upto 2015. Thus the aspects of lending can be evaluated and reestablished. Within the framework of the present study, it was attempted to construct a ratio model, which enable early identification of pattern for bankruptcy. The ratios are divided into pillars to state the area of financial viability. Neural network has been used for the forecasting of financial ratios. The financial position of the banks when the go out to obtain credit can be computed. The forecasted position can also benefit in planning the repayment period and also assists to plan the terms of credit.

As portrayed by Altman and Narayan 1998 several flaws existed in this traditional system of credit analysis. It is non-suitable for reasons like it is very expensive to maintain and has significant redundancies. These lead to incorporation of experts for maintenance of assets and liabilities of any bank. At all times any bank must have enough experts to handle its business Volume and should resort to techniques to train more people to render as experts in the long run. Furthermore classic credit analysis has often forced banks into a false sense of security. Failing to protect them against many of the systematic risks embedded in their area of business. Times have suggested that the traditional credit management schemes have led to disappointing results since banks have done a relatively poor job of pricing and managing credit risk. Today the environment of credit has altered and so have the terms of lending too. Credit lending has undergone a transformation over the past two decades due to introduction of credit scoring models. However, the process of granting commercial credit has also changed but the rate is much slower. To evaluate loan applicants, banks use a large variety of systems. The objective of such credit scoring models typically is to minimize default rates or the number of incorrectly classified loans. Thereby they fail to take into account that loans are multiperiod contracts. From a utility maximizing perspective it is not only important to know if but also when a loan will default.

## 2. BRIEF LITERATURE REVIEW:

Credit risk is probability that a borrower will fail to make required payments of principle and interest over the life of the loan. Risk plays an important role in the lending arena. At loan inception, the lender estimates the expected credit risk that the borrower presents over the life of the loan. Absent provisions to control the increase in credit risk, the lender prices the expected outcome in the interest rate of the loan. Both lender and borrower suffer when the expected credit risk of borrower is high, the lender with increased risk over the life of the loan and the borrower with a high interest rate. These suggest that both the parties involved in credit lending benefit when provisions are included in contrast to control increase in credit risk. Bankruptcy is the condition in which a business cannot meet its debt obligations petitions a federal district court for either. This paper examines an alternative approach using neural network to forecast financial ratios so as to relate to prediction of bankruptcy before it actually occurs.

Academic studies seeking to predict corporate bankruptcies have a long history. An early study was based on a univariate analysis approach (Beaver 1966). Multivariate analysis techniques used in subsequent studies include discriminant analysis (Altman 1968), logit and probit regressions (Ohlson 1980, Zmijewski 1984) and hazard analysis (Shumway 2001). The exact variables used in these studies vary and include both accounting-based and market-based variables, but all of these studies have proposed reduced form models which are able to predict corporate bankruptcies with a fair degree of accuracy. Shumway (2001) compares the forecasting accuracy of a hazard model using a set of five variables, comprising two accounting-based and three market-based variables, to Altman's (1968) and Zmijewski's (1984) specifications which used mainly accounting-based variables, and concludes that the hazard model with accounting and market-based variables is the most accurate. In an examination of secular changes in the ability of accounting variables to predict bankruptcy, Beaver et al. (2005) find a slight decline in the predictive ability of financial ratios based on accounting variables over the period 1962 to 2002, with a corresponding improvement in the incremental predictive ability of market-based variables.

Structural models of default, based on Merton (1974) and commercialized by firms like Moody's KMV (Crosbie and Bohn 2001), have also been studied (e.g., Vassalou and Xing 2004; Hillegeist et al. 2004). Although Hillegeist et al. (2004) find that these structural models

outperform purely accounting-based, reduced form models, Campbell et al. (2008) find that information from structural models does not add any additional explanatory power to reduced form models utilizing both accounting and market information. Bharath and Shumway (2008) show that the functional form suggested by the Merton model is useful for predicting defaults, though it does not serve as a sufficient statistic for the probability of default.

### **3. MODEL DESIGN AND METHODOLOGY**

In this paper, a two step methodology has been adopted. The part A provides the steps formulated for the prediction of financial ratio pillars, followed by part B which enlists the steps followed for the prediction of financial ratios using artificial neural networks.

#### **Part A: Formulation of Ratio Pillars**

The basic ratios are formulated from details mentioned in published statements like balance sheet, cash flow statements, yearly details of banks, profit and loss statements obtained from CMIE database, Reserve Bank of India. Data is also taken from the official websites of the banks and financial institutions and the internet. Prior researchers have identified financial ratio for bankruptcy prediction and the usefulness of these financial ratios for bankruptcy prediction can be known from the literature survey. Consequently this research work uses financial data i.e. published time series data for the last 11 years from 2000 to 2009. This research tries to present a holistic view by incorporating all various ratios and then relating them to examine the explanatory capabilities of the financial ratios to suggest the position of the bank. Construction of the basic ratios into ratio pillars is a vital ingredient of the basic work done prior to deployment of neural network.

Part A: Eight ratio pillars have been constructed for the needful being

1. Investment Valuation Ratio Pillar.
2. Profitability Ratio Pillar.
3. Management Efficiency Ratio Pillar.
4. Profit & Loss Ratio Pillar.
5. Debt Coverage Ratio Pillar.
6. Cash Flow Indicator Ratio Pillar.
7. Leverage Ratio. Ratio Pillar.
8. Overall Performance Ratio Pillar.

#### Part B: Prediction of Financial Ratios using ANN Model

1. Catering to Neural Network inputs
2. Tolerance level Minimization
3. Data convergence using Neural Networks
4. Formulation of Absolute error
5. Prediction of ratios in each Ratios pillar
6. Data Validation

#### **4. BPNN Model application – Case of SBI**

State Bank of India (SBI) is often compared to an elephant for its size. Although earlier, it has lost some share to private banks, its aggressive stance now, to shore up its business when most of its peers are cautious is noteworthy, is helping SBI enhance its market share. SBI's market share in terms of business volumes has been on an ascendancy (around 16 per cent in deposits and advances) from its lows in 2007. Well-diversified loan portfolio, strict monitoring and risk management measures, would help it to tide over the current economic slowdown. SBI's presence in rural and sub-urban regions is a distinct advantage over its private peers. A large branch network and improving distribution network would sustain greater volumes from rural areas. Greater propensity to mobilize low-cost deposits and technology-driven connectivity would ensure profitability, besides volumes from these regions. State Bank of India is the nation's largest and oldest bank. Tracing its roots back some 200 years to the British East India Company (and initially established as the Bank of Calcutta in 1806), the bank operates more than 15,000 branches within India, where it also owns majority stakes in six associate banks. State Bank of India (SBI) has more than 80 offices in nearly 35 other countries, including multiple locations in the US, Canada, and Nigeria. The bank has other units devoted to capital markets, fund management, factoring and commercial services, credit cards, and brokerage services. The Reserve Bank of India owns about 60% of State Bank of India.

Key numbers for fiscal year ending

The basic input sheets for all the eight pillars are formulated for SBI. The process of ratio pillar formulation uses the book formulae for computation of the ratios in each pillar, which will further

be used as input parameters for Artificial Neural Network. The details of the ratios and the values are enlisted in the table 1.

**Table1: Ratios used as Inputs for the Neural Network.**

Ratio Pillar	Tolerance	Ratios	2000	2001	2002	2003	2004	2005	2006	2007	2008
Investment Valuation	0.1	Dividend Per Share	1	1	1	1	2	3	6	10	10
		Operating Profit Per Share (Rs)	2.56 4	3.65 4	4.87 9	5.5 76	27. 289	69. 32	57	74.5 3	109. 81
		Net Operating Profit Per Share (Rs)	30.2 3	39.6 2	45.5 6	53. 232	150 .04	308 .04	310. 53	383. 89	505. 09
		Free Reserves Per Share (Rs)	68.8 28	68.2 96	67.7 64	67. 232	66. 7	63. 79	69.6 1	64.2 9	63.7 9
		Earnings Per Share	17.0 6135	19.4 8455	20.2 345	15. 291	17. 651	18. 144	22.6 7599	31.8 085	44.8 542
		Book Value	10.4 0833	18.0 5333	26.5	31. 74	41. 79	44. 72	45.6 5	48.8 4	64.9 8
		Net Operating Income per share	88.8 5167	109. 4567	135. 6	139 .59	176 .81	248 .93	287. 79	321. 65	341. 98
Profit & Loss		Interest Expended / Interest Earned	33.8 99	37.0 84	40.2 69	43. 454	46. 639	52. 64	51.3 1	52.2	61.2
		Other Income / Total Income	5.22 6	4.80 4	4.38 2	3.9 6	3.5 38	4.6 2	1.33	1.52	1.43
		Operating Expense / Total Income	44.8 9	42.3 68	39.8 46	37. 324	34. 802	30. 19	31	30.3 6	23.1
	0.1	Selling Distribution Cost Composition	0.27 4	0.25 8	0.24 2	0.2 26	0.2 1	0.1 9	0.2	0.14	0.14
		Current Ratio	0.04	0.04	0.04	0.0	0.0	0.0	0.03	0.03	0.02

			7	4	1	38	35	3			
		Quick Ratio	5.00	5.63	6.25	6.8	7.5	5.9	10.6	11.1	9.4
			9	4	9	84	09	8	9		
Profit ability	0.1	Interest Spread	3.19	3.31	3.44	3.5	3.6	3.6	3.94	4.4	4.18
			2	8	4	7	96	7			
		Adjusted Cash Margin (%)	18.1	17.7	17.2	16.	16.	15.	16.3	14.1	13.7
			79	08	37	76	29	64	5		2
		Net Profit Margin	14.8	14.6	14.4	14.	14.	13.	14.5	12.5	12.6
			48	5	52	25	05	84		3	8
		Return on Long Term Fund (%)	1.30	14.7	28.2	41.	55.	81	74.5	80.7	111.
	9	7	31	692	153		7	6	52		
Return on Net Worth (%)	16.7	17.1	17.5	17.	18.	22.	17.0	16.0	19		
	75	8	85	99	39	49	1	3			
Adjusted Return on Net Worth (%)	8.30	9.73	11.1	12.	14.	17.	15.8	15.1	18.9		
	6	2	58	584	01	95	3	7	9		
Gross Profit Ratio	0.75	0.76	0.74	0.7	0.7	0.7	0.71	10.7	10.6		
		9	1	62	52	25		96	0		
Lever age	0.1	Financial Leverage	7.65	6.72	4.68	3.3	3.3	3.4	3.77	3.64	3.57
			8	3	5	48	37	17	7	9	
		Net financial leverage	107.	109.	97.2	82.	70.	49.	45.2	46.8	54.6
			49	17	47	47	78	20	6	59	3
		Operating Leverage	0.00	0.00	0.00	0.0	0.0	0.0	0.00	0.00	0.00
			017	015	013	001	001	001	009	007	005
						3	2				
Interest Coverage	1.15	1.17	1.27	1.4	1.4	1.4	1.36	1.37	1.38		
		5	1	26	28	14		8	8		
Long Term Debt / Equity	971.	1194	1318	115	125	122	1302	1507	186		
	066	.64	.715	1.2	1.6	4.9	.529	.214	8.47		
				51	02	66			9		
Debt-Equity ratio	255.	299.	343.	324	385	400	460.	515.	631.		



			035	214	548	.99	.72	.38	728	136	21
						7	1	5			
		Owner's fund as % of Total Source	0.84 4	0.87	0.85 1	0.9 18	0.9 36	0.9 62	0.96 8	0.97 2	0.87 5
		Total debt to assets ratio	0.88 9	0.89 4	0.88 5	0.8 87	0.8 72	0.8 39	0.87	0.87 3	0.86 4
		Long term debt to assets ratio	0.88 9	0.89 4	0.88 5	0.8 87	0.8 72	0.8 39	0.87	0.87 3	0.86 4
Debt Cover age		Credit Deposit Ratio	35.1 31	39.4 36	43.7 41	48. 04	52. 35	56. 33	60.6	65.9 7	70.5 5
		Investment Deposit Ratio	67.7 56	63.4 06	59.0 56	54. 70	50. 35	48. 56	41.1 6	33.2 3	32.3 8
		Cash Deposit Ratio	14.7 72	14.2 22	13.6 72	13. 12	12. 57	8.4 8	14.7 4	13.7 8	9.02
		Total Debt to Owners Fund	8.78 1	9.57	10.3 59	11. 14	11. 93	13. 14	13.1 9	13.7 9	15.4 4
	0.1	Financial Charges Coverage Ratio	1.66 9	1.63 8	1.60 7	1.5 76	1.5 45	1.6	1.39	1.42	1.42
		Financial Charges Coverage Ratio Post Tax	1.48 2	1.45 6	1.43	1.4 04	1.3 78	1.3 6	1.33	1.29	1.25
Cash- flow	0.1	Dividend Payout Ratio Net Profit	1.70 8	4.52	7.33 2	10. 144	12. 956	14. 01	14.9 8	30.7 1	23.4
		Dividend Payout Ratio Cash Profit	0.54 3	2.30 6	5.15 5	8.0 04	10. 853	12. 4	13.2 6	27.2 6	21.6 1
		Earning Retention Ratio	98.2 76	95.4 64	92.6 52	89. 84	87. 02	85. 98	84.9 9	69.2 8	76.5 9
		Cash Earning Retention Ratio	100. 552	97.7	94.8 48	91. 996	89. 144	87. 6	86.7 2	72.7 3	78.3 8
		Adjusted Cash	71.8	71.8	71.7	71.	71.	64.	73.7	80.6	75.0

		Flow Times	54	22	9	75	72	77	3	5	5
Managerial Efficiency	0.1	Interest Income / Total Funds	5.41	5.85	6.29	6.7	7.1	8.5	7.23	7.88	8.86
		Interest Expended / Total Funds	1.21	1.66	2.11	2.5	3.0	3.9	3.63	3.92	4.86
		Operating Expense / Total Funds	3.19	3.07	2.94	2.8	2.7	2.7	2.27	2.43	2.08
		Profit Before Provisions / Total Funds	1.17	1.27	1.36	1.4	1.5	2.1	1.29	1.53	1.96
		Net Profit / Total Funds	0.88	0.92	0.96	1.0	1.0	1.2	1.06	1	1.14
		Loans Turnover	0.18	0.18	0.17	0.1	0.1	0.1	0.15	0.14	0.15
		Total Income / Capital Employed (%)	5.83	6.24	6.65	7.0	7.4	8.9	7.33	8	8.99
		Interest Expended / Capital Employed (%)	1.21	1.66	2.11	2.5	3.0	3.9	3.63	3.92	4.86
		Asset Turnover Ratio	4.87	4.90	4.94	4.9	5.0	5.2	4.75	5.48	4.35
		Overall	0.1	Capital Adequacy Ratio	9.12	9.61	10.1	10.	11.	11.	11.8
Advances / Loans Funds (%)	59.0	61.0		62.9	64.	66.	68.	65.6	76.1	78.3	
Return on invested capital (ROIC)	0.06	0.05		0.05	0.0	0.0	0.0	0.05	0.04	0.03	
Return on Equity (ROE)	0.20	0.24		0.24	0.2	0.2	0.3	0.18	0.17	0.20	

	Fixed Assets Ratio	1.36 6	1.59 3	1.85 1	2.0 62	2.4	3.6 42	3.38 6	3.59 9	3.87 2
	Capital Turnover Ratio	3.29 8	3.05 8	2.86 2	2.6 01	2.1	1.8 04	1.22 1	1.27 1	1.40 7
	Sales /net fixed Assets	7.97	8.61 6	9.18 3	9.8 69	8.7 93	9.4 01	9.92 9	11.1 99	14.1 2

Source:- CMIE Database

## 5. BPNN Modeling analysis, results and outcomes

After the computation of the basic ratio pillars, as suggested by Table 1, this section uses the ratios in each pillar as inputs to train the network. The network after training computes the values of the ratios from 2009 upto the year 2015 at different tolerance level. The validation is done by the values obtained for the year 2009 and 2010. The tolerance level that provides the closest values is considered for prediction. The Table 2 provides details of the convergence study done for all the pillars for the bank in the study. Table 3 provides details of the percentage error at the adopted level of tolerance.

**Table 2: The convergence detail for SBI.**

Ratio Pillar	Size	Tolerance Level	Epochs
Investment Valuation Ratio	1-8-7	0.1	2009693
Profit & Loss Ratio	1-7-6	0.1	2020624
Profitability Ratio	1-8-7	1	5788184
Leverage Ratio	1-10-9	1	7399332
Debt Coverage Ratio	1-7-6	0.1	1362687
Cash Flow Ratio	1-6-5	0.1	1445500
Managerial Efficiency Ratio	1-10-9	0.1	0.1
Overall Ratio	1-8-7	2	3557337

**Table 3: The percentage error and Tolerance Level for the Eight Ratio Pillars:**

Ratio Pillar	Tolerance	Ratios	2009.00			2010.00		
			Actual	Predicted	%Error	Actual	Predicted	%Error
Investmen	0.10	Dividend Per Share	29.00	27.43	5.40	25.89	25.18	2.74

t Valuation		Operating Profit Per Share (Rs)	230.04	227.36	1.17	229.51	225.43	1.78
		Net Operating Profit Per Share (Rs)	1179.45	1120.76	4.98	1181.31	1166.64	1.24
		Free Reserves Per Share	373.99	331.75	11.29	362.43	348.60	3.82
		Earnings Per Share	72.90	70.42	3.40	72.51	71.24	1.75
		Book Value	106.56	108.88	-2.18	115.75	116.44	-0.59
		Net Operating Income per share	776.48	768.09	1.08	778.25	764.20	1.81
Profit & Loss	0.10	Interest Expended / Interest Earned	67.28	1.18	22.91	0.33	0.04	5.74
		Other Income / Total Income	69.16	1.56	24.58	0.31	0.06	6.08
		Operating Expense / Total Income	-2.80	-32.22	-7.30	5.17	-42.93	-5.93
		Selling Distribution Cost Composition	69.64	0.59	23.61	0.31	0.05	7.31
		Current Ratio	70.12	1.25	25.38	0.30	0.06	6.97
		Quick Ratio	-0.70	-110.18	-7.49	1.39	-22.44	4.67
Profitability	0.10	Interest Spread	4.34	6.42	-47.84	4.13	7.40	-79.18
		Adjusted Cash Margin (%)	13.04	12.74	2.30	12.38	10.72	13.42
		Net Profit Margin	12.03	10.84	9.88	11.54	10.84	6.11
		Return on Long Term Fund (%)	100.35	96.33	4.01	94.90	96.20	-1.37

		Return on Net Worth (%)	15.74	15.24	3.21	14.32	13.14	8.28
		Adjusted Return on Net Worth (%)	15.74	15.23	3.21	14.33	15.15	-5.70
		Gross Profit Ratio	12.85	11.26	12.38	12.91	11.46	11.24
Leverage	0.10	Interest Income / Total Funds	4.08	3.53	13.65	2.58	3.45	-33.56
		Interest Expended / Total Funds	13.73	14.01	-1.99	12.62	12.53	0.69
		Operating Expense / Total Funds	-0.12	0.00	102.99	0.26	0.00	98.64
		Profit Before Provisions / Total Funds	1.33	1.34	-1.10	1.47	1.42	2.85
		Net Profit / Total Funds	1253.4	1159.42	7.50	1171.12	1174.23	-0.27
		Loans Turnover	1519.0	1513.05	0.40	1407.96	1450.86	-3.05
		Total Income / Capital Employed (%)	91.27	89.26	2.21	87.46	88.22	-0.87
		Interest Expended / Capital Employed (%)	1.00	1.00	0.00	1.00	1.00	0.00
		Asset Turnover Ratio	0.83	0.82	0.40	0.84	0.84	-0.21
Debt Coverage	0.10	Credit Deposit Ratio	74.97	36.38	8.37	12.81	1.36	1.23
		Investment Deposit Ratio	69.87	41.50	7.91	13.63	1.42	1.25
		Cash Deposit Ratio	6.81	-14.06	5.52	-6.38	-4.34	-1.88
		Total Debt to Owners Fund	79.90	32.45	8.96	11.74	1.34	1.22
		Financial Charges Coverage Ratio	73.81	36.16	8.24	12.51	1.42	1.25
		Financial Charges	7.62	-11.43	8.06	-6.61	-5.92	-3.04

		Coverage Ratio Post Tax						
Cash-flow	0.10	Dividend Payout Ratio Net Profit	22.90	22.96	5.74	24.14	21.59	4.91
		Dividend Payout Ratio Cash Profit	21.13	21.89	-1.40	22.39	21.43	2.24
		Earning Retention Ratio	77.11	76.09	0.12	75.87	77.02	-0.29
		Cash Earning Retention Ratio	78.88	78.93	-1.23	77.61	79.85	-1.70
		Adjusted Cash Flow Times	75.05	77.67	-3.30	76.50	77.53	-1.53
Manageria 1 Efficiency	0.10	Interest Income / Total Funds	9.82	10.41	-5.96	8.82	10.54	- 19.45
		Interest Expended / Total Funds	5.83	6.18	-5.96	4.74	6.27	- 22.29
		Operating Expense / Total Funds	2.60	2.77	-6.36	2.59	2.78	-7.47
		Profit Before Provisions / Total Funds	1.30	1.33	-2.00	1.41	1.30	7.51
		Net Profit / Total Funds	0.96	1.09	- 13.76	1.08	1.10	-1.74
		Loans Turnover	0.18	0.16	11.69	0.17	0.16	6.47
		Total Income / Capital Employed (%)	9.90	10.43	-5.30	8.90	10.55	- 18.57
		Interest Expended / Capital Employed (%)	5.83	6.18	-5.96	4.74	6.27	- 22.29
		Asset Turnover Ratio	5.14	5.50	-7.09	4.60	5.59	- 21.50
Overall	0.10	Capital Adequacy Ratio	14.25	13.43	5.75	14.40	13.70	4.90
		Advances / Loans Funds	78.34	77.06	1.63	80.60	78.13	3.07

	(%)						
	Return on invested capital (ROIC)	0.01	0.02	-7.75	0.35	0.01	96.29
	Return on Equity (ROE)	0.16	0.20	-24.36	0.15	0.19	-27.08
	Fixed Assets Ratio	41.52	38.97	6.15	47.00	43.33	7.81
	Capital Turnover Ratio	0.09	0.10	-12.03	0.03	0.10	-262.76
	Sales /net fixed Assets	19.86	20.06	-0.99	21.07	20.53	2.52

Source:- CMIE Database

## 6. OBSERVATIONS:

The ANN has been trained for prediction of ratios in each ratio pillar. This section provides a discussion of findings over the predicted ratios. It suggests the ratios that would viably be predicted in this model terming them as included ratios. It also provides the details of the ratios that cannot be predicted and would be excluded from the study. The section provides details of the predicted ratios of each pillar for all the pillars for the banks in the study. Certain suggestions and recommendations are also provided based on the analysis. The ratio pillars have further been described in detail:

The validation was carried out for all the ratios. By the analysis of standard error the included ratios and excluded ratios were formulated. The ratios that have shown a deviation greater than 25% from the actual field data estimates are ignored. Such ratios are termed as excluded ratios. The excluded ratios have not been considered in the prediction process and have been dropped out from the prediction process. The ratios are enlisted in Table 4. The estimates from 2001 to 2008 were applied to train the backpropagation neural network and subsequently estimate the values for the year 2009 to 2010 the data values were used for validation. Based on these values predictions were drawn using BPNN from 2011 to 2015. The market has witnessed several ups and downs during the period 2005 and 2010 and the modeled BPNN has been able to closely predict the values from 2005 to 2010. The trained BPNN has been able to forecast the values of

the internal included ratios of the ratio pillar in approximation to the actual values suggesting that the BPNN has the ability to forecast the financial ratios.

Table 4: Included and Excluded ratios for SBI

Ratio Pillars	SE	Total	Included Ratios	Excluded Ratios
IVR	0.1	7	7- Dividend Per Share, Operating Profit Per Share (Rs), Net Operating Profit Per Share (Rs), Earnings Per Share, Book Value, Net Operating Income per share	1- Free Reserves Per Share (Rs),
Profitability	0.1	7	4: Adjusted Cash Margin (%), Net Profit Margin, Return on Net Worth (%), Adjusted Return on Net Worth (%)	3: Interest Spread, Return on Long Term Fund(%), Gross profit Ratio
P&L	0.1	6	4- Interest Expended / Interest Earned, Operating Expense / Total Income, Selling Distribution Cost Composition, Quick Ratio	2-Other Income / Total Income, current ratio
Debt Coverage	0.1	6	4- Credit Deposit Ratio, Investment Deposit Ratio, Cash Deposit Ratio, Total Debt to Owners Fund	2- Financial Charges Coverage Ratio, Financial Charges Coverage Ratio Post Tax
Cash Flow	0.1	5	5:Dividend Payout Ratio Net Profit, Dividend Payout Ratio Cash Profit, Earning Retention Ratio, Cash Earning Retention Ratio, Adjusted Cash Flow Times	Nil
SBI	0.1	9	9:Interest Income / Total Funds, Interest Expended / Total Funds, Operating Expense / Total Funds, Profit Before Provisions / Total Funds, Net Profit / Total Funds, Loans	Nil



			Turnover, Total Income / Capital Employed(%), Interest Expended / Capital Employed(%), Asset Turnover Ratio	
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Source:- CMIE Database

## 7. ANALYSIS & FINDINGS:

As per the above convergence study the table 5 provided the details of the size of ANN used for prediction and the associated level of tolerance.

Table 5: Details in brief of the predicted ratios in all eight pillars:

Ratio Pillar	Tolerance	Ratios	2009.00	2010.00	2011.00	2012.00	2013.00	2014.00	2015.00
Investment Valuation	0.1	Dividend Per Share	16.45	20.58	27.43	25.18	26.22	26.83	27.21
		Operating Profit Per Share (Rs)	154.42	180.50	227.36	225.43	213.35	216.90	219.10
		Net Operating Profit Per Share (Rs)	829.11	945.25	1120.76	1166.64	1094.13	1110.90	1121.44
		Earnings Per Share	60.11	69.75	70.42	71.24	65.45	66.23	66.74
		Book Value	86.09	90.23	108.88	116.44	102.87	103.70	104.20
		Net Operating Income per share	539.67	628.50	768.09	764.20	731.80	742.05	748.27
Profit & Loss	0.20	Adjusted Cash Margin (%)	12.74	10.72	10.70	9.68	8.66	7.64	6.63
		Net Profit Margin	10.84	10.84	9.84	10.83	10.83	11.98	10.83
		Return on Net Worth	15.23	13.1	12.0	12.95	12.8	14.77	14.6

		(%)		4	4		6		8
		Adjusted Return on Net Worth (%)	15.23	15.1	15.0	14.97	14.8	14.81	14.7
				5	6		9		4
Profitability	0.10	Interest Expended / Interest Earned	69.16	70.1	72.8	73.51	74.0	74.42	74.7
				2	9		1		6
		Operating Expense / Total Income	24.58	25.3	25.2	26.03	26.8	26.77	26.6
				8	0		9		6
		Selling Distribution Cost Composition	0.31	0.30	0.27	0.27	0.27	0.27	0.28
		Quick Ratio	6.08	6.97	7.79	6.88	6.95	7.00	7.04
Leverage	0.10	Net financial leverage	14.01	12.5	12.5	12.53	12.5	13.58	13.6
				3	3		5		4
		Interest Coverage	1.34	1.42	1.43	1.42	1.35	1.36	1.36
		Long Term Debt / Equity	1159.4	1174	1187	1200.3	1212	1024.	837.
			2	.2	.7	3	.4	67	80
		Debt-Equity ratio	1513.0	1450	1508	1518.4	1519	1519.	1519
				.8	.		.0	08	.0
		Owner's fund as % of Total Source	89.25	88.2	90.9	91.26	91.2	91.27	91.2
				2	6		7		7
		Total debt to assets ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Long term debt to assets ratio	0.82	0.84	0.83	0.82	0.84	0.82	0.82
Debt Coverage	0.20	Credit Deposit Ratio	69.87	73.8	74.6	75.34	70.9	71.50	71.9
				1	3		6		7
		Investment Deposit Ratio	41.50	36.1	35.8	36.64	36.4	35.42	34.4
				6	7		9		3
		Cash Deposit Ratio	7.91	8.23	8.50	8.72	8.89	8.94	8.15
		Total Debt to Owners Fund	13.63	12.5	12.4	12.29	12.2	13.10	13.0
				1	0		0		2

Cash-flow	0.20	Dividend Payout Ratio	21.59	22.9	23.2	23.60	21.8	24.14	24.0
		Net Profit		5	9		9		0
		Dividend Payout Ratio	21.42	21.8	20.3	21.71	21.0	21.38	18.6
		Cash Profit		9	2		6		6
		Earning Retention Ratio	77.02	76.0	75.1	74.24	74.3	70.36	75.4
		9	7		0		2		
		Cash Earning Retention Ratio	79.85	78.9	76.0	76.08	76.1	76.21	75.2
				3	1		5		7
		Adjusted Cash Flow Times	77.53	77.6	77.7	77.92	78.0	78.14	78.2
				6	9		3		4
Managerial Efficiency	0.10	Interest Income / Total Funds	9.71	8.84	8.93	8.99	9.02	9.04	9.06
		Interest Expended / Total Funds	6.64	6.23	6.49	6.57	6.63	6.66	6.68
		Profit Before Provisions / Total Funds	1.31	1.48	1.15	1.04	0.93	0.85	0.78
		Loans Turnover	0.16	0.15	0.15	0.15	0.15	0.15	0.16
		Total Income / Capital Employed (%)	9.94	9.13	9.25	9.33	9.38	9.42	9.44
		Interest Expended / Capital Employed (%)	6.64	6.16	6.49	6.58	6.63	6.66	6.68
		Asset Turnover Ratio	4.41	5.48	5.95	6.60	6.63	6.66	6.67
Overall	0.40	Capital Adequacy Ratio	13.43	12.4	12.4	12.49	12.5	12.51	12.5
				5	7		0		2
		Advances / Loans Funds (%)	73.96	74.4	74.8	75.07	75.2	75.38	75.4
				6	2		5		7
		Return on invested capital (ROIC)	0.04	0.03	0.02	0.02	0.01	0.01	0.01
		Fixed Assets Ratio	4.05	4.13	4.19	4.23	4.25	4.27	4.28
		Capital Turnover Ratio	0.86	0.66	0.68	0.71	0.73	0.74	0.75

**Source:- CMIE Database**

The Investment Valuation Ratio Pillar it has been observed that the Dividend per Share moves in the range from 5% to 34% and the similar swing of 2% to 33% has been predicted by the neural network. The ratio Operating Profit Per Share (Rs) shows a movement of 1% to 33% as suggested by the network also being 0.4% to 25%. The ratio Net Operating Profit Per Share (Rs), shows a movement of 0.1% to 26% as suggested by the network also being 0.4% to 20%. For Earnings Per Share shows a movement from 0.5% to 23% is observed and the network shows a similar fashion being approximately 0.4% to 16%. For Book Value shows a movement from 2% to 23% is observed and the network shows a similar fashion being approximately 0.2% to 20%. For Net Operating income per share shows a movement from 0.2% to 30% is observed and the network shows a similar fashion being approximately 0.3% to 22%.

In the Profitability ratio pillar the Adjusted Cash Margin (%), moves in the range from 7% to 32% and the similar swing of 5% to 18% has been predicted by the neural network. The ratio Net Profit Margin shows a movement of 5% to 16% as suggested by the network also being 0.5% to 15%.

In the Profit and Loss Ratio pillar it has been observed that the Interest Expended / Interest Earned moves in the range from 5% to 7% and the similar swing of 1% to 9% has been predicted by the neural network. The ratio Operating Expense / Total Income shows a movement of 0.3% to 10% as suggested by the network also being 3% to 7%. For Selling Distribution Cost Composition shows a movement from 3.7% to 10% is observed and the network shows a similar fashion being approximately 2% to 14%. For Quick Ratio shows a movement from 5% to 17% is observed and the network shows a similar fashion being approximately 0.5% to 14%.

In the leverage ratio pillar it has been observed that the Net Financial Leverage moves in the range from 2% to 20% and the same movement of ratios has been predicted by the neural network of 0.5% to 17%. For the Interest Coverage the ratios oscillate in the range from 0.8% to 5% and the network suggests a similar trend. For the Long term debt to assets ratio shows a movement from 3% to 22% is observed and the network moved a similar pattern of 1% to 22%. For Debt –Equity Ratio shows a movement from 7% to 31% is observed and the network moved a similar pattern from 1% to 33%. For Owner's fund as % of Total Source shows a movement from 4% to 30% is observed and the network moved a similar pattern. For Total debt to assets ratio shows a movement from 0.1% to 0.1% is observed and the network moved a same pattern.

For Long term debt to assets ratio shows a movement from 0% to 2% is observed and the network moved a similar pattern.

In the Debt Leverage Ratio it has been observed that Credit Deposit Ratio shows a movement of 3% to 5% as suggested by the network also being 1% to 5%. For Investment Deposit Ratio shows a movement from 4% to 15% is observed and the network shows a similar fashion being approximately 2% to 12%. For Cash Deposit Ratio shows a movement from 2% to 45% is observed and the network shows a similar fashion being approximately 4% to 40 %. For Total Debt to Owners Fund shows a movement from 1.2% to 21% is observed and the network shows a similar fashion being approximately 0.8% to 16 %.

In the Cashflow ratio pillar it has been observed that the Dividend Payout Ratio Net Profit show a range of 1% to 11% a similar kind of error in the range of 1% to 19% is predicted by the network. The Dividend Payout Ratio cash Profit moves in the range from 2% to 17% and the similar swing of 2% to 12% has been predicted by the neural network. The ratio Earning Retention Ratio shows a movement of 0.1% to 8% as suggested by the network also being 1% to 7%. The ratio cash Earning Retention Ratio shows a movement of 0.62% to 5% a similar trend of 1% to 9% is projected by the network. For Adjusted Cash Flow Times shows a movement from 0.14% to 12% is observed and the network shows a similar fashion being approximately 0.1% to 14%.

In the Managerial Efficiency ratio pillar it has been observed that the Interest Income / Total Funds show a range of 0.6% to 6%, similar kind of error in the range of 0.2% to 10% is predicted by the network. The Interest Expended / Total Funds moves in the range from 0.6% to 12% and the similar swing of 12% to 20% has been predicted by the neural network. The ratio Operating Expense / Total Funds shows a movement of 0.04% to 9% as suggested by the network also being 0.001% to 0.8%. The ratio Profit before Provisions / Total Funds shows a movement of 0.5% to 12% a similar trend of 0.1% to 13% is projected by the network. For Net Profit / Total Funds, shows a movement from 1% to 20% are observed and the network shows a similar fashion being approximately 0.3% to 26%. The Loans turnover ratio being shows a movement from 0.6% to 6% is observed and the network shows a similar fashion being approximately 0.2% to 6.6 %. The ratio being Total Income / Capital Employed (%) shows a movement from 0.3% to 5% is observed and the network shows a similar fashion being approximately 0.1% to 5%. The Interest Expended / Capital Employed (%), shows a movement from 0.6% to 12% is observed

and the network shows a similar fashion being approximately 0.2% to 12%. The Asset Turnover Ratio shows a movement from 5% to 18% is observed and the network shows a similar fashion being approximately 0.7% to 17%.

The study suggests that SBI has been continuously improving its operating efficiency with the cost-to-average assets ratio declining from 2.46% in FY06 to 2.23% in FY07. It is also raising its thrust on non-interest income, which formed nearly 30% of total income in FY07. Currently, India's loan-to-GDP ratio is still low at 41% compared to other emerging economies. This provides enormous scope for the Indian financial services sector. SBI has finally begun leveraging its wide distribution network and size to gain meaningful market share. After declining consistently for the last few years, its market share has stabilized at around 15- 16% during last six months. Advances surged 29% y-o-y to Rs 33, 7340 crore in FY07. We expect its loan book to grow at 23.5% in FY08E and 17% in FY09E to Rs 487,560 crore on the back of its suitable positioning to reap the benefits of India growth story. As of March 31, 2007, the share of retail advances to total advances was 21.5%. Retail sector credit has grown 20% y-o-y and exposure to housing sector has fallen from 12% to 11% of total portfolio. The overall cost of funds is expected to rise further to 5.4% in FY07 from the current 4.96%. But on an overall basis, the growth in the cost of funds for SBI has been lower than most others. In the past, SBI had surplus liquidity that supported its high credit growth despite IMD redemptions. Deposits grew at 14.6% y-o-y in FY07, which was lower than the industry average. The reason was the high base and dip in SBI's market share. In FY06 also, growth in deposits appeared to be slower at 3.5% on account of redemption of IMD deposits of Rs 23,014 crore. If there is a provision to exclude the IMD deposits, growth was 9.8%. With excess SLR lowering to nearly 27% in FY07, SBI will now onwards need to rely on bonds and debt to fund its balance sheet growth. There is an expect deposits to rise 17% and 13.3% in FY08E and FY09E respectively, but still lower than expected deposits growth in industry of around 20%. The share of retail deposits is rising which shows SBI has refrained from raising bulk deposits thereby lowering the cost of funds. Bulk deposits form nearly 17% of total deposits. SBI is not expected to increase its branch network aggressively and is expected to leverage the current extensive network of over 9,000 branches. We expect CASA deposits to remain stable at current levels of 43-44% for the next couple of years. Considering, the large balance sheet size of Rs 566,500 crore, CASA level of 43% is also huge. Cost of deposits have grown from 4.57% to 4.79% in FY07 and is expected to rise further

to 5.03% by FY09E. The yields on average assets are expected to rise on expanding balance sheet due to recent rate hikes. Further the cost of funds is also increasing. The bank's fee-based income has grown at a CAGR of 13% over FY03-07 and is expected to continue growing at a CAGR of 13% over FY07 –09E to Rs 6,134 crore. Gross and net NPAs as a percentage of advances have fallen to 2.92% and 1.56% respectively as of March 31, 2007 from 3.61% and 1.88% as of March 31, 2006. SBI is the largest bank and has largest asset book. The bank's loan loss provision ratio is currently 46.3% and is projected to go up to 52% by FY09 thereby bringing net NPA levels to 1.11% by FY09E. The bank's capital adequacy ratio (CAR) at the end of March 31, 2007 was 12.34% with Tier I CAR at 8.01%. During H2FY08, the bank intends to undertake a further equity dilution, which we have assumed at 7%, in order to bolster its Tier I CAR. The fresh infusion of capital should help the bank grow its balance sheet size at a CAGR of 15% over FY07-09E to Rs 116,789.3 crore. Total assets have grown at a CAGR of 11% during last 5 years. Net profit for FY07 grew by 3% y-o-y to Rs 4,541 crore. Core fee income grew 20% y-o-y to Rs.4805 crores giving positive trend on the core income front. Non-interest income will continue to be one of key contributors in overall profitability with its share accounting for 31% of total net income in FY07. Currently, 75% of investment book is in HTM category with balance in AFS category with duration of less than 2 years. With net NPA's also gradually sliding down, overall provisions remain between 0.7% to 0.8% of average assets.

## **8. CONCLUSION:**

In times of economic distress the model would provide assistance to finding the financial viability of the firm. As the ratio pillars incorporate all the terms to be included while assessment of the firm's financial position there are less chances of being misguided in the terms of credit lending. This model would act as an early warning system for the corporate as has long been desired. The tailored back-propagation neural network endeavors to predict the financial ratios expressing the position of a firm to regulate the bankruptcy and assess the credit viability when a bank requires credit and can also be utilized to plan the periods of recovery of the lent amount. The analysis also suggested the forecast of the financial position of the firm in case of loan value enhancement as well as the extension of the repayment period. This also renders to be effective in the designing of policies related to credit viability thus proves to be a vital tool to regulate the occurrence of credit defaults. This paper provides an alternative method for gaining insights into

the dynamics of recovery rates for distressed bank lending over longer periods of time, i.e. through economic cycles. Since the late 1980s, banks of most developed countries have reported on the level of loans and other assets considered impaired from a credit risk perspective. Moreover, banks not only report the gross book value of these assets but typically also their expected realizable value thus providing a point in time estimate of overall recovery rates of their total distressed asset portfolio. These values can be interpreted as a proxy for expected recoveries by bank management just as the distressed price based methods represent market expected recovery values of corporate bonds. The main benefit of the method is that recovery estimates are for a representative composition of bank distressed credit exposures rather than the specific bond portfolios of the traditional bond LGD literature. It also enables analysis over longer periods and mirrors outcomes for the whole system, not just a single bank.

## BIBLIOGRAPHY

- ALTMAN, EDWARD [1968]: "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy", *The Journal of Finance*, Vol 13, n.4, September, pp. 589-609.
- ALTMAN, EDWARD [1984]: "The success of business failure prediction models: an international survey", *Journal of Banking and Finance*, pp. 171-198.
- ATIYA, AMIR [2001]: "Bankruptcy prediction for credit risk using neural networks: a survey and new results", *IEEE Transactions on Neural Networks*, Vol. 12, n.4, July, pp. 929-935.
- BEAVER, WILLIAM H.; MCNICHOLS, MAUREEN F.; RHIE, JUNG WU [2005]: "Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy", *Review of Accounting Studies*, n.10, pp. 93-122.
- BHARATH SREEDHAR T., SHUMWAY TYLER, (2008)" Forecasting Default with the Merton Distance to Default Model", *The Review of Economic Times*, Volume21, Issue3,Pp. 1339-1369.
- CAMPBELL, STEVEN V. [1996]: "Predicting bankruptcy reorganization for closely held firms", *Accounting Horizons*, Vol. 10, n. 3, September, pp. 12-25.
- COLLINS, ROBERT A.; GREEN, RICHARD [1982]: "Statistical methods for bankruptcy forecasting", *Journal of Economics and Business*, n. 34, pp. 349-354.



- DEAKIN, EDWARD [1972]: "A discriminant analysis of predictors of business failure", *Journal of Accounting Research*, Spring , pp. 167-179.
- EDMINSTER, ROBERT O. [1972]: "An empirical test of financial ratio analysis for small business failure prediction", *Journal of Financial and Quantitative Analysis*, March, pp. 1477- 1493.
- GORDON, M. J. [1971]: "Towards a theory of financial distress", *Journal of Finance*, n. 26, May, pp. 347-356.
- HILLEGEIST, STEPHEN; KEATING, ELIZABETH; CRAM, DONALD, LUNDSTEDT, KYLE [2004]: "Assessing the probability of bankruptcy", *Review of Accounting Studies*, n.9, pp. 5-34.
- KEASEY, KEVIN; MC.GUINNESS, PAUL [1990B]: "The failure of U.K. industrial firms for the period 1976-1984, logistic analysis and entropy measures", *Journal of Business, Finance and Accounting*, Vol. 17, n. 1, Spring, pp. 119-135.
- MENSAH, WAW H. [1983]: "The differential bankruptcy predictive ability of specific price level adjustments: some empirical evidence", *The Accounting Review*, Vol. LVIII, n. 2, April, pp. 228-246.
- MENSAH, YAW H. [1984]: "An examination of the stationarity of multivariate bankruptcy prediction models: a methodological study", *Journal of Accounting Research*, Vol. 22, n.1, Spring, pp.380-395.
- MEYER, PAUL A.; PIFER, HOWARD W. [1970]: "Prediction of bank failures", *The Journal of Finance*, Vol.25, n.4, September, pp. 853-868.
- MERTON, ROBERT C., "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates", *Journal of Finance*, Vol. 29, No. 2, (May 1974), pp. 449-470
- OHLSON, JAMES A. [1980]: "Financial ratios and the probabilistic prediction of bankruptcy", *Journal of Accounting Research*, Vol 18, n.1, Spring, pp. 109-131.
- SCOTT, JAMES [1981]: "The probability of bankruptcy", *Journal of Banking and Finance*, n. 5, pp. 317-344.
- SHUMWAY, TYLER [2001]: "Forecasting bankruptcy more accurately: a simple hazard model", *Journal of Business*, Vol 74, n.1, pp.101-124.

- STEVENS, DONALD L. [1973]: “Financial characteristics of merged firms: a multivariate analysis”, *Journal of Financial and Quantitative Analysis*, March, pp. 149-158.
- WILCOX, JARROD W.[1971]: “A simple theory of financial ratios as predictors of failure”. *Journal of Accounting Research*, Autumn, pp. 389-395.
- ZHANG, GUOQIANG; HU, MICHAEL Y.; PATUWO, EDDY B.; INDRO, DANIEL C. [1999]: “Artificial neuronal networks in bankruptcy prediction: general framework and cross validation analysis”, *European Journal of Operational Research*, n. 116, pp. 16-32.
- ZMIJEWSKI, MARK E. [1984]: “Methodological issues related to the estimation of financial distress prediction models”, *Journal of Accounting Research*, Vol. 22, supplement, pp. 59-82.