Z Score Reveals Credit Capacity: A Case Study of SBI

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Abstract

The prediction of corporate financial failure, crucial for the prevention and mitigation of economic downturns in a national economy, requires the categorization of healthy and unhealthy companies. This study examines the case of SBI and applies artificial neural network architectures—the self-organizing map —to assess the corporate financial health of the firm. The research work first estimates the internal parameters of the Z Score for a firm, these parameters 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 Z Score computation of financial Bankruptcy.

Keywords: BPNN, neural network, credit lending, Z sore

JEL Classification: G24

1. Introduction

The ability to provide accurate predictions of corporate bankruptcy is of great importance both from an individual and a collective point of view. From an individual's perspective, alongside owners, employees, customers, suppliers, certified accountants and other counterparties of companies, in particular banks are interested in accurate bankruptcy predictions, as in case of bankruptcies of their customer's they have to reckon considerable losses. From a bank's perspective powerful insolvency predictions are a fundamental prerequisite for enabling risk commensurate credit charges and/or the embodiment of non-financial credit terms, for improving the cost-efficiency of its credit processes for improving the liquidity of the bank's assets and for increasing the controllability of credit risks via securitization of individual credits or entire portfolios and also for determining and controlling economic and regulatory capital demands. From a national economy perspective, the employment of powerful insolvency prediction models by creditors is an important precondition for guaranteeing the soundness and stability of the banking system and for the implementation of risk-sensitive loan terms which provide a motivation for incentive compatible, risk sensitive behavior of debtors.

2. Literature Survey

Several researches have been conducted in the area. O'Leary (2001) argues that prediction of bankruptcy probably is one of the most important business decision-making problems affecting the entire life span of a business, failure results in a high cost from the collaborators (firms and organizations), the society and the country's economy

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(Ahn, Cho, and Kim, 2000). Over the last 35 years, the topic of company failure prediction has developed to a major research domain in corporate finance. Academic researchers from all over the world have been developing a gigantic number of corporate failure prediction models, based on various types of modelling techniques. Besides the classic cross-sectional statistical methods, which have produced numerous failure prediction models, researchers have also been using several alternative methods for analyzing and predicting business failure. Till date, a clear overview and discussion of the application of alternative methods in corporate failure prediction is still lacking. Research has shown that most business failure is caused by bad or poor management (Ahn et al., 2000). This could be in the form of inexperienced management styles, fraud, and rapid technological changes amongst other variables. Financial failure may take the form of bankruptcy or insolvency. Bankruptcy refers to a condition where the total liabilities exceed the fair value of assets. Financial statements are normally used to gauge the performance of the firm and its management. The financial statements commonly used are profit and loss statement, balance sheet and cash flow statements. From the financial statements, various ratios can be calculated to assess the current performance future prospects of the concerned firm. Some of the ratios used include current ratio, quick ratio, and working capital to total debt, total debt to total assets, profit margin to sales and return on total assets (Ahn, 2000). Perhaps the best way to avoid failure is to examine the myriad explanations for business failure. Studies carried out by Altman (2003) used financial ratios to predict occurrence of bankruptcy and he was able to predict 94% correctly one year before bankruptcy occurred and 72% two years before its actual occurrence. Dimitras, Koksal, and Kale (2006) pointed out that after 30 years of research on this topic, there is no generally accepted model for business failure prediction that has its basis in a causal specification of underlying economic determinants. Because of the confusingly varied and restrictive assumptions underlying these classic statistical models, there is need to recourse to alternative methods.

Prior empirical studies of failure have concentrated almost exclusively on financial ratio data, though other studies of failure usually cite managerial variables as being critical (Scherr, 2002). The usefulness of ratio-based business failure prediction models has been questioned. For example, El-Zayaty (2003) find ratio models to be poor predictors of bankruptcy: of 132 businesses predicted to fail, only 5 were discontinued over a five-year period. Storey et al. (2000) indicate that qualitative data can provide at least as good predictions as traditional financial ratios. In Kenya, Keige (1991) did a study on business failure prediction using discriminant analysis. Kiragu (1993) did another study on the prediction of corporate failure using price adjusted accounting data. Kogi (2003) did an analysis of the discriminant corporate failure prediction model based on stability of financial ratios. Altman is known for the development of the Z-Score formula, which he published in 1968. The Z-Score for predicting Bankruptcy is a multivariate formula for a measurement of the financial health of a company and a powerful diagnostic tool that forecasts the probability of a company entering bankruptcy within a 2 year period. Studies measuring the effectiveness of the Z-Score have shown that the model has 70%-80% reliability. The Z Score analysis has been the base for research in this paper.

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 internal parameters of Z Score, followed by part B which enlists the steps followed for the prediction of Z Score using artificial neural networks.

Part A: Formulation of Internal Parameters of Z Score

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. Consequently this research work uses financial data i.e. published time series data for the last 11 years from 2000 to 2009.

1. (Current Assets-Current Liabilities)/Total Assets
2. Retained Earnings/ Total Assets.
3. EBIT/ Total Assets
4. Equity/Total Liabilities

Part B: Prediction of Z Score Internal Parameters using BPNN

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 for State Bank of India

State Bank of India (SBI) is often compared to an elephant for its size. Although earlier, it had 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 ascendency (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.

The basic input sheets for all the internal parameters are formulated for State bank of India. The process of input ratio formulation uses the book formulae for computation of the ratios, which will further be used as input parameters for Artificial Neural Network. The Altman Z-Score prediction uses the Neural Network (1, 5, 4).The number of input rows are 1. The hidden layers are 5 and the outcomes are 4 internal parameters. The input point is time and output has been the required ratios. The period for input has been from 2000-2006 which has been normalized from 1 to 8.The details of the ratios and the values are enlisted in the table 1.

Table 1. Training Pattern for SBI Internal Parameters of Z-Score

	Input Parameters			
Time	*(CA-CL)/Total Assets*	*Retained Earnings/ Total Assets*	*EBIT/ Total Assets*	*Equity/ Total Liabilities*
2000	0.73659	0.049465	0.077749	0.002013
2001	0.781807	0.046565	0.077392	0.001667
2002	0.791241	0.047891	0.075746	0.001511
2003	0.796349	0.052424	0.064382	0.0014
2004	0.805242	0.057737	0.061314	0.001291
2005	0.837653	0.058967	0.058853	0.001144
2006	0.827194	0.061765	0.062825	0.001066

A Backpropogation Neural Network has been used to transfer data sets. Trained network is used for prediction of ratios for the forthcoming two years being 2008, 2009, and 2010. The initial weights of the neural paths were in the range of -0.02 to 0.05. Convergence study of neural network was carried out for difference tolerance error of 1,0.75,0.5,0.4,0.3,0.2,0.1,0.01,0.001. The predicted values obtained from the neural network were compared with the actual field data or the arithmetic computation done from the published statements.

Table 2. Z-Score Convergence Study for SBI

Tolerance	*Ratios*	*2008*			*2009*			*2010*		
		Actual	*Predicted*	*% Error*	*Actual*	*Predicted*	*% Error*	*Actual*	*Predicted*	*% Error*
	Retained Earnings/ Total Assets	0.0854	0.0650	23.9487	0.0794	0.0676	14.8341	0.0677	0.0700	-3.3350

Tolerance	*Ratios*	*2008*			*2009*			*2010*		
	EBIT/Total Assets	0.0748	0.0594	20.5561	0.0791	0.0589	25.5990	0.0635	0.0586	7.7366
	Equity/Total Liability	0.0011	0.0010	6.0949	0.0009	0.0010	-15.6433	0.0007	0.0010	-51.2262
	Z Value	6.2630	6.0365	3.6177	6.1298	6.0484	1.3269	6.2630	6.0583	3.2683

A BPNN of size 1-5-4 is used for prediction. The error of tolerance to stop the execution was 0.01. It took the network 1644455 epochs to converge.

5. BPNN Modelling analysis, results and outcomes

After the computation of the basic ratio pillars, as suggested by Table 1, this section uses the ratios as inputs to train the network. The network after training computes the values of the ratios from 2008 upto the year 2015 at different tolerance level. The validation is done by the values obtained for the year 2008 to 2010.The tolerance level that provides the closest values is considered for prediction. A 1-6-5 size backpropagation neural network is used for prediction of the Z-Score internal parameters. The internal parameters are then used in the formula to find the Z-Score value for the banks upto the year 2015. Table 3 provides details of the percentage error at the adopted level of tolerance.

Table 3. Prediction of Internal Parameters of Z-Score using BPNN.

S.No	*Tolerance*	*Years*	*Output (Current Assets – Current Liability) / Total Assets*	*Retained earnings/ Total Assets*	*Earning Before Interest and Tax / Total Assets*	*Equity/Total Liability*
1	0.01	2009	0.82233	0.06815	0.05891	0.00102
2		2010	0.82336	0.07064	0.05875	0.00100
3		2011	0.82422	0.07277	0.05876	0.00099
4		2012	0.82495	0.07457	0.05885	0.00098
5		2013	0.82557	0.07606	0.05899	0.00097
6		2014	0.82611	0.07730	0.05915	0.00096
7		2015	0.82657	0.07831	0.05929	0.00095

6. Observations & Findings

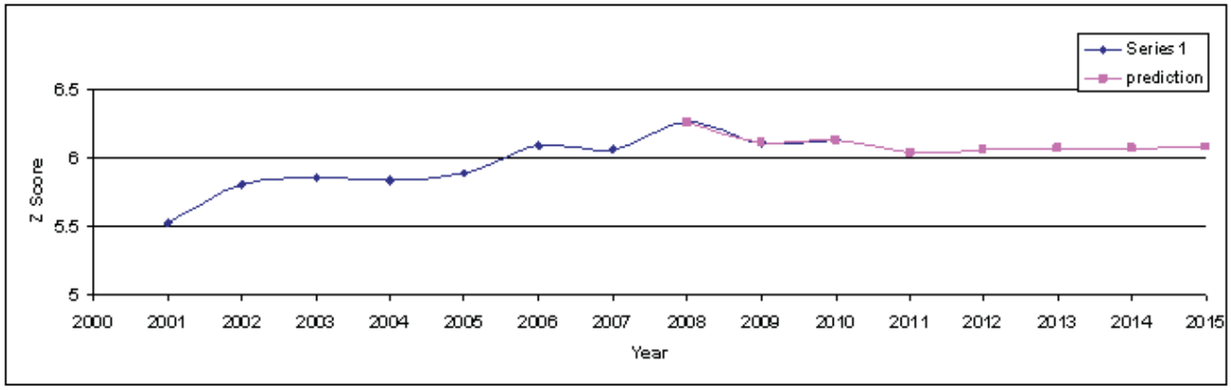
The validation was carried out for all the internal parameters of Z-Score value. The Z-Score internal parameter estimates were considered from 2001 to 2007 and were applied to train the backpropagation neural network and subsequently estimates of the year 2008 to 2010 were used for validation. Based on these values predictions were drawn using BPNN from 2011 to 2015. These values have then been substitutes in the Z-Score formula for market credits to compute the Z-Score values from 2008 to 2015. The market has witnessed several ups and downs during the period 2005 and 2010 and the modelled BPNN has been able to closely predict the Z-Score values from 2005 to 2010. The trained BPNN has been able to forecast the Z-Score values in approximation to the actual values suggesting that the BPNN has the ability to forecast the Z-Score parameters financial ratios

Year	2009	2010	2011	2012	2013	2014	2015
Z Score	6.110547	6.129766	6.041783	6.053048	6.062925	6.071476	6.078811

The Z Score values reveal that it is safe to lend to SBI as the values lie in the safe zone. The bank can get credit at relaxed norms. Even the period of repayment can be long.

For SBI bank the movement of Z-Score has been from 0.4% to 5.1%. The trend exhibited by the predicted value is from 0.1% to 3%. (Figure 1).

Figure 1. Z-Score SBI Bank



7. Conclusion

The tailored BPNN is found to be of immense utility at the time of predicting the viability of lending to any firm. The obtained Z score validation suggests that the neural network can predict closely. The tailored back-propagation neural network endeavours to predict the internal parameters 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. For the analysis, different combinations of short-term debts and long-term debts as a proxy for a firm's liabilities were used to examine whether the liquidity constraint from short-term liabilities alone actually forces firms to declare bankruptcy, or if we should consider that the amount of long-term debts is also relevant to determining a firm's bankruptcy probability.

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