

A Comparative Study of Iranian Banks' Efficiency by Using Artificial Neural Networks and Multi-Linear Regression

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Abstract: The goal of this research is to forecast the performance of 10 Iranian banks using multi-linear regression method and artificial neural network and to compare these two methods. To do so, the financial data related to 10 Iranian banks during the years between 2006 and 2010 were collected from the most reliable resources. By using the regression method, the relationship between the calculated efficiency of ROA (Return on Average Assets) as the dependent variable and the independent variables was investigated. The findings of multi-linear regression method showed a positive relationship between efficiency and the 3 independent variables of size, cost to income ratio, and inflation rate. Then, ROA was used as an output for the network in the artificial neural network and 7 different inputs were used to identify the pattern according to the predictive variables. A desirable neural network with 9 neurons was achieved in the hidden layer. Finally the performances of these two methods were measured by using MSPR (Means Square Predicted Error). The results of the research showed that the amount of MSPR in multi-linear regression method is much lower than the MSPR amount in artificial neural network method. This means that the regression method presents a better performance compared to neural networks in predicting the efficiency of Iranian banks.

Keywords: Bank efficiency, Multi-linear regression, Artificial neural network

1. Introduction:

A safe banking system reflects safety in a society's economics to a great extent. The banking system plays an important role in Iranian economic system. It should be noted that nowadays financial entities in the whole world are trying to increase the efficiency in way that they use the rare resources besides using the competition advantages resulted from the reduction of service costs. Hence, entities have increased to their profitability and social welfare level. After studying the related literature, we found multi-linear regression method as the most common statistical method for predicting the performance of the banks. This method is very useful and simple for determining the profitability of the banks and thus in determining the performance of the banks. Of course, where there is not a suitable mathematical relationship between the data and independent and dependent variables, the neural network can lead us wards better results. Thus, in this research, we will use artificial neural network in predicting the performance of the banks. Finally the prediction capabilities of both methods were compared in this research to find a more powerful tool to predict the banks' performance. In fact, our aim in this research is to study the prediction of Iranian banks' efficiency by using artificial neural network and multi-linear regression methods and their comparison with each other.

2. Literature Review:

Divandari & et al (2004) designed a model for predicting in managing liquidity in financial foundations regarding the banking principles without interest, by using an artificial neural network. The results showed that neural networks are suitable tools to predict the needs for liquidity. By artificial neural networks we can

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make the needed decisions about equipping and optimized appropriation of the resources and reduce the liquidity risks in microeconomics and macroeconomics.

Nikbakht and Sharifi (2010) studied the prediction of firms' financial bankruptcy in Tehran Stock Exchange (Bourse) by using neural networks. In their research, the precision of the results from both neural networks and MDA analysis model were compared. Also the verification of neural networks' predictions was carried out by using ROC diagrams. The results showed the higher precision in neural networks in differentiation between companies which encountered bankruptcy and those which didn't. Also they had lower level type 1 and type 2 errors compared with MDA.

Atyas (2001) studied the prediction of bankruptcy by using credit risk while using artificial neural networks. In his paper, after studying the bankruptcy prediction by neural network, a new model was created for bankruptcy prediction. Using one of credit risk models, a new criterion was proposed for artificial neural networks. The results show the high precision of this model.

Kyung & et al (2004) showed in their article that by using a multi-layered neural network instead of a single neural network, we can increase the prediction precision of companies' bankruptcy.

Anwar & Mikami (2011) compared the precision amount of neural networks with Multiple-linear regression (MLR) and GARCH model in predicting the return time of the deposits in Islamic banks. The results showed that neural network model entails a higher amount of precision in comparison to the other two approaches.

Odeh & et al (2010) used the 3 methods of artificial neural network, logistic regression and adaptive neuron-fuzzy inference system to predict the credit default. Using the data resulted from the banking industry, they concluded that there is a slight difference between the precision of the 3 models investigated. The comparative study of the 3 models showed that ANFIS has a better performance than other methods.

Abu Bakar & Tahir (2009) used multiple linear regression and neural networks in their article to predict the bank's performance. The results showed that using neural networks method gained superiority over multiple linear regression method in banks' performance prediction.

3. Research Variables:

The variables used in this research are presented in the following table.

Table 1: research variables

variables	The intended parameter
Y	ROA: Return on average assets which serve as performance indicator (<i>dependent Variable</i>)
X1	LIQ: Loan-to-assets ratio as a measure of liquidity
X2	LLOSS: Loan loss provision-to-loans ratio as a measure of credit risk
X3	SIZE: Size of a bank based on its total assets
X4	COSTINC: Cost income ratio which measures bank efficiency
X5	CONC: A concentration ratio, calculated by taking the largest 3 banks divided by total assets of the banking sector
X6	GDP: Gross Domestic Product
X7	CPI: Consumer Price Index

4. The Statistical Population:

The statistical Population in this research involves 10 main banks from among Iranian banks in a time period between the years 2006 and 2010. The reason of this selection was due to the lack of accessibility to data about other banks.

5. Research Hypothesis:

Artificial neural networks have a higher efficiency in comparison with multiple-linear regression.

6. Research Methodology and Research Hypothesis Analysis:

To realize the research goal, first the data needed for the research were classified in EXCELL and then the variables were inserted in SPSS to be analyzed and by using the multi-linear regression and Stepwise methods they were tested to decide which one of the 7 independent variables should be used in the linear model. Accordingly only the variables of size, cost to income ratio, and inflation rate were used to estimate the regression model and the final results are presented in the following table:

Table 2: the results of multi-linear regression method

Model	Non-standardized Coefficients	
	B	Std. Error
(Constant)	.054	.010
X4	-.003	.000
X3	.002	.000
X6	-7.765E-17	.000

Then the research variables were divided into three groups of training, validation and testing. %80 was appropriated to training, %10 to validation, and finally %10 to testing. To achieve it, we used MATLAB software. In this research, a hidden layer was used to design neural networks. Also the number of input layers was considered to be equal with the prediction variables. Regarding the fact that there is only one output in the network, the number of output layer equals 1. It is not easy to determine the number of middle (hidden) layers and mostly we have used the trial and error method to do so in way through which the total performance of the network has improved. Also back propagation training algorithm has been utilized to train neural networks. Network training's performance function was considered to be equal with the mean square of errors (MSE). After several testing and calculating the errors, the best status of network performance with high adjustability, with 9 neurons in the middle (hidden) layer with an error of 0.000148 and determination coefficient of 0.68 were selected.

7. Research Findings and Conclusion:

In this research we comparatively studied the banks' performance prediction by using multi-linear regression and artificial neural network methods. Accordingly, the data needed were collected from 10 Iranian banks and an analysis was carried out by using the methods mentioned above. The research findings show that MSPR of the neural networks (0.000141) has been higher than regression model (0.0000164) used in predicting the banks' performance in Iran. Thus, the research hypothesis which predicts a higher efficiency for the neural networks compared with the regression model is rejected. We can conclude that in Iranian banks prediction with using multi-linear regression results in much more appropriate results, compared with the model designed by the neural networks. Of course, one of the reasons of this incident could be due to the limited number of our research statistical society.

8. References:

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