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Research Paper

The Strength of Convolutional Neural Network in Financial Distress Prediction[1]

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INTRODUCTION

Uncertainty has always been an inherent phenomenon in financial decision-making, exposing decision makers to various types of risks. One prominent risk faced by financial managers is financial distress. Consequently, predicting this event using diverse features extracted from financial statements has been a prominent topic among scholars in this field. Each year, numerous research studies are conducted using various prediction methods to address this topic. In this study, the literature on financial distress prediction is reviewed, starting from the early definitions proposed in 1966. The domestic definition of financial distress in Iran is provided and distinguished from the international definition. Additionally, the limitations of classic prediction methods are

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reviewed, and the subsequent methods used in this area are studied. Given the distinction between domestic and international definitions of financial distress, the reviewed studies are divided into two parts: Iranian publications and international publications. In summary, most studies on financial distress prediction consist of two main steps. Firstly, they select features to be used as inputs for the prediction method, employing various approaches. Secondly, the selected features are incorporated into a prediction model to solve a classification problem or, in some cases, a regression problem. In this paper, a new method for financial distress prediction is introduced. Specifically, a deep learning method called Convolutional Neural Network is utilized for a binary classification prediction task. As this method falls under the umbrella of deep learning, the feature extraction process is performed during the model's training process. Consequently, the first step in other prediction studies is condensed into the second step of the proposed model. Ultimately, the aim of this study is to compare the prediction accuracy of the proposed method with earlier benchmark methods in this field.

MATERIALS AND METHODS

In this paper, a Convolutional Neural Network (CNN) is trained to solve a binary classification problem. The labels for this prediction task represent the normal condition of the firm (0) and the occurrence of distress (1) at the target year. The model is built using 14 different financial statement ratios from three consecutive years leading up to the target year. The features are organized into a 3*14 matrix, which is used for the predictions of 0 and 1. The specific neural network architecture used in this study is designed to extract knowledge from two-dimensional feature vectors using special kernel matrices. These kernel matrices help extract relevant features by representing the raw input features. As a result, the final classifying network is provided with a representation of the raw data that reduces the impact of irrelevant features in the prediction task. This means that the feature extraction process of the convolutional neural network encompasses the first step of earlier

studies on financial distress prediction, eliminating the need for a separate feature selection or extraction model. To mitigate the generalization error caused by randomly selecting train-test samples, the k-fold method is employed. Five random sub-samples are created, and in each iteration, one sub-sample is chosen as the test data while the rest are used for training. To compare the performance of the proposed method, two benchmark methods are trained on the same samples, and the results are recorded. Finally, the statistical significance of the methods is assessed using the Wilcoxon sign rank test.

RESULTS AND DISCUSSION

Result from the accuracy metric implies that Convolutional Neural Networks perform better than the benchmark methods while classifying each of the subsamples of the test dataset. Furthermore, the results from the Wilcoxon sign rank test show that convolutional neural networks significantly perform better than the rest of the methods within a 95 percent confidence interval.

CONCLUSION

The literature on financial distress prediction has undergone significant evolution since 1966. One major shift has been the move from classic linear methods, like the one proposed by Altman, to machine learning-based predictions that are prevalent today. This study introduces a new evolution in prediction methods that is necessary for financial distress prediction. The implementation of CNN in this paper has demonstrated its significant outperformance compared to other benchmark methods. To mitigate generalization errors, the study has utilized the K-fold technique, which enhances the reliability of the results. This evolution offers two key benefits. Firstly, deep learning methods like CNNs excel in pattern recognition and can achieve higher accuracy. Secondly, these methods have streamlined the model implementation process by integrating feature extraction within the main prediction model. As database

technology and data collection techniques continue to advance, the advantages of deep learning methods are likely to become even more prominent.

Keywords: Convolutional Neural Network, Deep Learning, Financial Distress, Prediction.

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