Forecasting the Accounting Profits of the Banks Listed in Iraq Stock Exchange Using Artificial Neural Networks

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Abstract

This paper demonstrates the feasibility of using deep learning approaches in time series forecasting of bank profits. Two types of neural networks were used, LSTM (Long-Short Term Memory) and NAR (Nonlinear Autoregressive) networks, for comparison. The data from 12 Iraqi banks, which are registered in the Iraq stock exchange, were involved in this study for sixteen years (2004-2019). RMSE and MAPE were used for comparing the performance of the two models (LSTM and NAR). Our results showed that the NAR is more accurate than LSTM for the prediction of profits. And that the use of the NAR network by the Iraqi banks will help them predict future accounting profits.

Keywords

Artificial Neural Networks, LSTM Long-Short Term Memory, Stock Exchange.

Introduction

The profits forecasting process is considered one of the main pillars of any management because of its positive impact on the decision-making process, realistic planning for the future, improving the efficiency of resource utilization, and its effects on economic and social development. As for banks, in addition to the positive effects above, the process of profits forecasting means an estimate of the possibility of going concerned, avoidance of financial failure, and bankruptcy. Also, the importance of the profit forecasting process is increasing for banks because their activities are mainly related to saving and investment at the level of the economy as a whole. On the basis of the importance of the profits forecasting

process for banks, it has become necessary to seek the use of modern digital technologies and software for the purpose of reaching forecasts with a high degree of accuracy and reliability. This research aims to study the possibility of using modern techniques represented by neural networks NAR (Nonlinear Autoregressive) and LSTM (Long-short Term Memory) in the process of profit forecasting in the Iraqi environment. The research sample included (12) banks registered in the Iraq Stock Exchange for the period 2004 – 2019.

Research Methodology

1. Research Problem

The weak reliance of banks in Iraq on modern techniques to forecast profits and means that there are banks with low performance that negatively affect the economy as a whole. Therefore, the research problem is represented in answering the following question:

((Will the use of neural networks by banks (the research sample) enable them to effectively forecast their profits?)).

2. Research Objective

1. Building an artificial neural network with appropriate specifications depending on the rule of trial and error to forecast or predict the accounting profits of Iraqi private banks.
2. Emphasizing the importance of neural networks in the forecasting and relative analysis of variables and their weights.

3. Research Importance

The banking system in Iraq is linked to a vital sector in the economy, especially since private banks are competing with the public sector in various activities.

4. Sources for Collecting Data and Information

1. Articles, Researches, Theses, and related dissertations to cover the theoretical aspect.
2. The financial reports of the banks selected as sample research published in the Iraq Stock Exchange to cover the applicable aspect.

5. Research Population and its Sample

The research population is represented by the (44) private banks listed in the Iraq Stock Exchange. As for the research sample, (12) banks were selected as a suitable sample for the research.

The Theoretical Aspect

1. Profit Forecasting

i. Forecasting Concept

Forecasting in the general sense means studies related to the future, whether through estimates based on an individual technique, or on comprehensive and organized scientific techniques, or statistical and mathematical techniques to measure the functional relationships between variables in order to determine the rates of change between them (Al-taweel, 2008). The forecasting process has taken on remarkable importance in many economic studies and researches to help decision-makers to formulate future policies for the phenomenon in question. The forecasting or prediction process is done by developing models to describe the time series that is being studied. Therefore, various techniques for prediction have emerged, including artificial neural networks (Abdul Majeed, 2018).

ii. Profit Forecasting Definition

Profit forecasting is the process of predicting future outcomes based on a series of past events. The profit forecasting process is based on past profits, and the sustainability of these profits increases the accuracy of their forecasting in the future (Al-Amoudi, 2016). Also, the profit forecasting process represents a profit planning process by preparing a set of planning budgets to serve as an integrated plan for the economic unit and is consolidated, taking into account that the data used in preparing the budget focus largely on the future rather than the past (Nouri, 2019).

iii. Techniques Used For Forecasting

There are systematic and non-systematic techniques that can be used in the forecasting process (Al-taweel, 2008).

Non-systematic Techniques in Forecasting Process

These techniques depend on experience and personal estimating and do not depend on a specific rule to explain the behavior of the variable, and are divided into:

1. Techniques of comparison.
2. Rely on expert's opinions.

Systematic Techniques in Forecasting Process:

1. Causal models: They depend on scientific methods in explaining the phenomena, as the relationship between variables is formulated in the form of estimable mathematical models.

2. Non-causal models: They depend on the historical values of the variables through which the behavior of these variables is explained, including:
   - Statistical models for time series.
   - Nonlinear dynamic models of time series.
   - Projections of the general trend of the time series.

In recent decades, modern techniques of forecasting have emerged, such as neural networks, which rely on artificial intelligence techniques, computer technologies, and simulate the mechanism of the human brain.

iv. Profit Concept

According to the definition of financial management, the profit represents a certain amount achieved by a specific activity or project and does not differ from the profit achieved by similar activities or projects that are exposed to the same degree of risks. To achieve this, the financial management must obtain the required funds with the lowest costs and risks and invest these funds in a way that achieves revenues not less than what the shareholders can obtain if their money is invested in other projects exposed to the same risks (Nouri, 2019)

According to the accounting concept, the profit is defined as the difference between total revenue and total costs or the amount remaining for an economic entity after paying the returns of production factors, interests, taxes, and depreciation (Gharbi, 2013).

v. The Importance of Accounting Profits

It is possible to benefit from the profits in the following areas (Shaheen, 2011).

1. Profits as a Basis for Tax

Accounting profits are considered an appropriate basis adopted by most tax legislation to determine the tax base, taking into consideration making the necessary adjustments to move from accounting profits to tax profit.

2. Profits and Distribution of Capital Returns

Profits represent a guide for the policies of investment and distribution of returns. When determining the accounting profit, the economic entity can adopt an appropriate policy for the amount of accounting profit that can be distributed as returns on capital or retained for allocation to the expansion of the activities of that economic entity.

3. Profits and Forecasting

Profits provide an initial basis for predicting their future development, whether the assessment is according to historical cost or current cost.

4. Profits as a Measure of the Effectiveness and Efficiency of Management:

Profits are used as a measure to evaluate the effectiveness and efficiency of management in terms of optimal use of available resources for the purpose of achieving the objectives of the economic entity of maximizing shareholders' profits and increasing sales and growth rates.

5. Profits as an Indicator of Borrowing:

Lending institutions depend on the financial statements of the economic entity in general with a focus on analyzing the elements of the income statement and forecasting the significance of their numbers in order to measure the ability of that economic entity to repay the loans that will be provided to it.

vi. The Importance of Profits Forecasting

The importance of profits forecasting is related to the level or degree of accuracy of that process. Also, the accuracy of forecasting is related to the fluctuation in profits of previous periods and the change in economic conditions. It is self-evident to say that profits are the most important measure of the result of the activities of the economic entity and future profits are the main influence on stock prices, and therefore, information related to profits represents the most important content of all accounting information (Alarthy, 2017).

The researchers believe that profit forecasting is a process of estimating or predicting future profits that are carried out according to scientific bases and statistical techniques to know the performance of the economic entity in the future, evaluate plans, predict the true value of the economic entity in the future, and help in facing future financial results and events.

2. Artificial Neural Networks

i. The Concept of Neural Networks

Artificial neural networks are considered one of the most important aspects of artificial intelligence that are used in various scientific fields and reflect a fundamental development of the human way of thinking because they represent a simulation of the neural network in the human brain through data processing to reach the best model for prediction or analysis purposes.

Recent years have witnessed great interest in artificial neural networks technology as a suitable alternative to traditional techniques for its ability to predict and solve problems with greater ease and accuracy compared to previous statistical techniques.

The use of the neural networks technique is a reliable, effective way to reach the best forecasting of future values related to a particular phenomenon. (Abdul Majeed, 2018:53)

There are several concepts and definitions of neural networks, including:

- A new technique in data analysis and prediction calculation through a structure to store and process data in parallel to reach the closest point of efficiency in performance compared to the efficiency of human vital neural networks (Faeq, 2012).
- A neural network is an artificial intelligence technique for processing information based on a computer.

The artificial neural network is inspired by the human neural network, and it consists of a large number of cells that communicate with each other and is organized in layers, the input layer and output layer, and between them, there are one or more intermediate layers called the hidden layer. (Almamori & Al-Husseiny, 2015).

Neural networks are characterized by a set of properties that help them to reach distinctive results and solve problems with high accuracy and sufficient flexibility. The most prominent of these characteristics are (1) learnability, (2) generality, (3) parallel processing, (4) error override. (Al-Hakkak & Al-Jarah, 2013).

ii. Long Short Term Memory Neural Networks (LSTM-NN)

The basic concept of neural networks (LSTM-NN) was introduced by (Hochreitet and schmidhuber 1997). This type of neural network is an improvement over recursive neural networks (RNN), and the feedback has been used to overcome the problem of decreasing regression to become suitable for dealing with important events that occur in the time series and predicting them after relatively long periods, and therefore it is now used in different applications. (Wu and Lin 2019), (Husein and Chung, 2019).

The LSTM cell consists of four gates: (Haider & others, 2019).

1. Input gate (it controls writing to the cell)
2. Output gate (how much to reveal the cell)
3. Forget gate (whether to erase the cell)
4. Write gate (how much to write to the cell)

iii. Non-linear Autoregressive Neural Networks (NAR-NN)

(NAR-NN) is a recurrent, dynamic neural network with feedback connections enclosing layers of the network? The next value of the dependent output signal is regressed on previous values of the output signal. The main advantage of using (NAR) network is that the input to the feed-forward network is more accurate, which provides the more precise result for multi-step ahead prediction. The (NAR) model is based on the linear (AR) model, which is commonly used in time-series forecasting (Benmouiza & Cheknane, 2016).

When using a (NAR) network, it performs only a one-step-ahead prediction after it has been trained. Therefore, a closed-loop network is used to perform a multi-step-ahead prediction and turn the network into a parallel configuration (Ruiz et al., 2016).

A Practical Application

The data used in this research is related to the annual profits of the banks selected as a sample for research for the period (2004 - 2019), which were obtained from the financial statements of those banks that were published in the Iraq Stock Exchange. Also, for the purpose of data processing and network design to reach the results of the research, the program MATLAB (R 2019 b) was used as follows:

1. The (smoothing function) was used as an initial stage to enter data into the network to obtain better results. Figure (1) shows the data before and after using the function on the profits of the Iraqi Middle East Investment Bank.

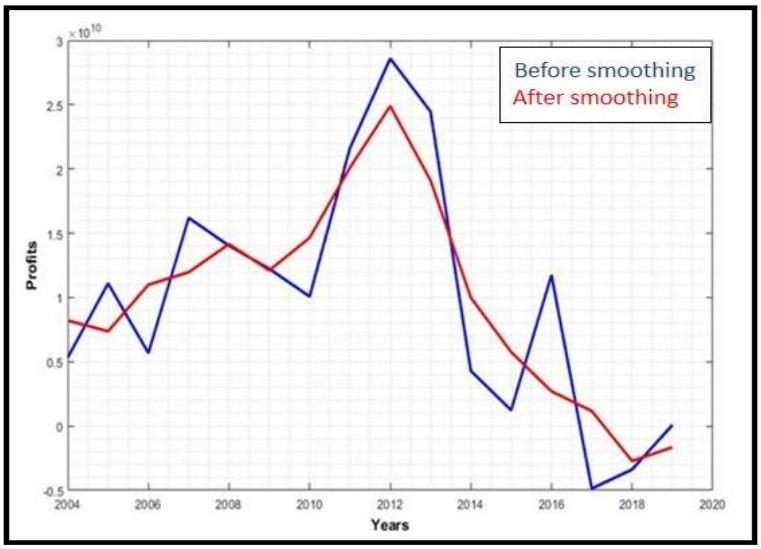

Figure 1 Iraqi Middle East Investment Bank data before and after processing
Source: Prepared by the researchers based on (MATLAB) program

The accuracy of the results of artificial neural networks depends on the accuracy and nature of the data. One of the techniques adopted in dealing with time series is the use of artificial neural networks through the process of smoothing the data before its inclusion in the neural networks (Haider & others, 2019). The data used in this research does not contain large fluctuations, so the data has been smoothed using a moving average, and the length of that moving average is determined based on the input values.

2. In order to reach the best model in the prediction process, the root of Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) functions will be used as measures to compare performance between the two models (LSTM) and (NAR) and the values of (RMSE) and (MAPE) are calculated using the following equations:

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{x_i - y_i}{x_i}\right| \qquad (1)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(x_i - y_i)^2}{n}} \qquad (2)$$

Where (x) is the real value (profits), (y) is the calculated value from the networks, and (n) is the number of observations (inputs).

Neural Network Model (LSTM)

Figure (2) shows the stages of using the (LSTM) network, where the data was divided into training data at a rate of (70%) and standardized to have a zero mean and unit variance to reduce error rates.

The (LSTM) network was designed and trained according to the following features:

- Number of Features (inputs) = 1
- Number of Responses (outputs) = 1
- Number of Hidden units (Hidden Layers) = 20

The stages of forecasting future profits include updating the network status for each point, i.e., using the previous value as an input to the network to calculate the future value.

To configure the network state, a prediction is made using the training data, and then the first value is predicted using the last test data.

Then, the predictions are returned to their base values using the previously calculated items (mean and standard deviation), and the error value is calculated using the (RMSE) between the prediction and test values (Shown in Table (1)).

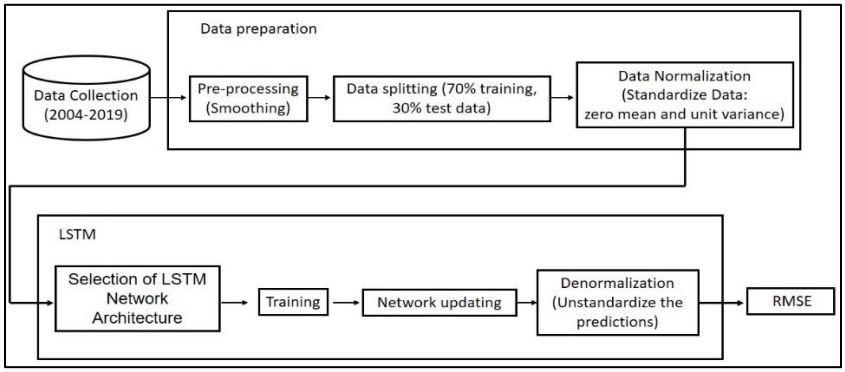

Figure 2 Stages of Using the (LSTM) Network

Source: Prepared by the researchers

Based on equations (1) and (2), the values of (RMSE) and (MAPE) are obtained for banks (the research sample), as shown in Table (1).

Table 1 Results of (RMSE) and (MAPE) values for the (LSTM) networks For banks (the research sample)

Banks	RMSE	MAPE
Iraqi Islamic Bank for Investment and Development	6,874,900,000	85.6133
Commercial Bank of Iraq	891,150,000	15.65
Investment Bank of Iraq	6,571,100,000	1699.9
Bank of Baghdad	2,808,700,000	108.34
Credit Bank of Iraq	11,484,000,000	1667.1
National Bank of Iraq	7,329,500,000	177.252
Gulf Commercial Bank	8,688,200,000	207.564
Iraqi Middle East Investment Bank	5,924,900,000	61.4466
United Bank for Investment	8,891,500,000	287.581
Mosul Bank for Development and Investment	8,776,100,000	253.138
Babylon Bank	1,519,900,000	40.8588
Sumer Commercial Bank	287,110,000	60.7213

Neural Network Model (NAR)

The stages of designing and using the (NAR) network are shown in figure (3), where the inputs were classified into three sections: training data (70%), Validation data (15%), test data (15%). The network was designed with the following specification:

- Number of hidden nods = 10
- Training algorithm (Levenberg Marquardt)
- Network type: closed-loop

The (RMSE) scale was used to select the best weights for the network. After choosing the weights, the neural network is closed (closed-loop) for the purpose of predicting the future stages. In this way, the network will have one input connected to the output. Many attempts have been made to predict profits for different numbers of years, and the best results are for only three years.

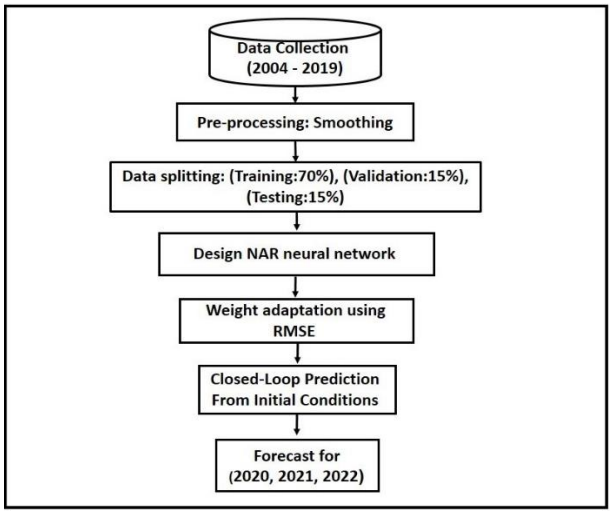

Figure 3 The Stages of Designing, Configuration, and Testing of (NAR) network
Source: Prepared by the researchers

Based on equations (1) and (2), the values of (RMSE) and (MAPE) are obtained for banks (the research sample), as shown in table (2).

Table 2 Results of (RMSE) and (MAPE) values for the (NAR) network for banks (the research sample)

Banks	RMSE	MAPE
Iraqi Islamic Bank for Investment and Development	1,178,788,339	1963.410735
Commercial Bank of Iraq	1,449,137,675	13.7616
Investment Bank of Iraq	2,112,107,952	245.3359
Bank of Baghdad	3,030,181,513	15.556
Credit Bank of Iraq	1,665,232,716	15.806
National Bank of Iraq	6,406,246,951	94.4561
Gulf Commercial Bank	8,046,117,076	59.3805
Iraqi Middle East Investment Bank	1,554,027,027	8.4043
United Bank for Investment	7,828,793,010	96.1466
Mosul Bank for Development and Investment	3,158,955,524	71.2533
Babylon Bank	508,035,432	4.3655
Sumer Commercial Bank	519,037,571	9.8377

Source: Prepared by the researchers based on (MATLAB) program

5- Table (3) below, comparing the values of (RMSE) and (MAPE) for the neural network (LSTM) and (NAR), shows that the values of (RMSE) and (MAPE) for the neural network

(NAR) are lower than they are for the neural network (LSTM). Therefore, the results of the neural network (NAR) will be used to predict future profits.

Table 3 A comparison between the results of (RMSE) and (MAPE) for the two networks (LSTM) and (NAR) for banks (the research sample)

Network Model	NAR		LSTM	
Banks	RMSE	MAPE	RMSE	MAPE
Iraqi Islamic Bank for Investment and Development	1,178,788,339	1963.411	6,874,900,000	85.613
Commercial Bank of Iraq	1,449,137,675	13.762	891,150,000	15.65
Investment Bank of Iraq	2,112,107,952	245.336	6,571,100,000	1699.9
Bank of Baghdad	3,030,181,513	15.556	2,808,700,000	108.339
Credit Bank of Iraq	1,665,232,716	15.806	11,484,000,000	1667.1
National Bank of Iraq	6,406,246,951	94.456	7,329,500,000	177.252
Gulf Commercial Bank	8,046,117,076	59.381	8,688,200,000	207.564
Iraqi Middle East Investment Bank	1,554,027,027	8.404	5,924,900,000	61.447
United Bank for Investment	7,828,793,010	96.147	8,891,500,000	287.581
Mosul Bank for Development and Investment	3,158,955,524	71.253	8,776,100,000	253.138
Babylon Bank	508,035,432	4.366	1,519,900,000	40.859
Sumer Commercial Bank	519,037,571	9.838	287,110,000	60.721

Source: Prepared by the researchers based on (MATLAB) program

6- According to table (4) below, profit forecasts were obtained using a neural network (NAR) for three years. The values of these forecasts reflect the following:

- The banks (Baghdad, National bank of Iraq, Gulf Commercial Bank, Iraqi Middle East Investment Bank, United Bank for Investment, Mosul Bank for Development and Investment, Sumer Commercial Bank) have increased their profits significantly during the three years in general. This indicates the soundness of financial policies and management decisions. This increase is also reflected in the quality of profits and the rise in the market value of these banks.
- The banks (Iraqi Islamic Bank for Investment and Development, commercial Bank of Iraq, Babylon Bank) have maintained a fairly constant level of profits for the three years. This indicates that the financial performance of these banks is considered good performance, despite the presence of some negatives that the management can overcome without the need for the intervention of regulatory oversight.
- High losses of the Investment Bank of Iraq and the Credit Bank of Iraq, and thus the high cost of capital, high risks, and low investment. This requires that these banks improve their financial policies, evaluate performance, and take several corrective measures specified by the regulatory oversight.

Table 4 Forecasts values for the years 2020, 2021 and 2022 (million dinars) for the banks selected as a sample for research

Banks	2020	2021	2022
Iraqi Islamic Bank for Investment and Development	6,925	7,042	8,320
Commercial Bank of Iraq	7,927	7,588	6,135
Investment Bank of Iraq	-3,448	-6,624	-7,384
Bank of Baghdad	13,267	15,207	13,702
Credit Bank of Iraq	-969	-3,100	-5,084
National Bank of Iraq	437	2,361	1,685
Gulf Commercial Bank	2,123	2,830	2,914
Iraqi Middle East Investment Bank	1,231	3,835	5,170
United Bank for Investment	7,687	26,953	30,038
Mosul Bank for Development and Investment	6,742	3,854	9,619
Babylon Bank	1,845	1,863	2,567
Sumer Commercial Bank	1,703	2,023	3,209

Source: Prepared by the researchers based on (MATLAB) program

Conclusions and Discussion

The use of neural networks by banks in Iraq to predict profits will help in the rational decision-making process. Analysis by this technique will require less time and effort than other traditional forecasting techniques that assume difficult conditions for time series analysis. The continuation of the banks to achieve profits in the future will increase the value of these banks, the confidence of the investors in them, and the increase in the value of the shares and vice versa. Forecasting through the use of a neural network (NAR) contributes to giving a clear picture of future profits, which provides useful information for management, current and potential investors in making rational investment decisions. Performing the process of smoothing the data before entering it into the neural network contributes to improving the training of the actual prediction process. The results of (RMSE) and (MAPE) values proved that the neural network (NAR) is better than (LSTM) in predicting future profits. The necessity of paying attention to forecasting by banks because it is an important tool that helps in estimating future profits and financial failure. The necessity is that the annual financial reports of banks in Iraq contain estimates of future profits to help investors forecast and make rational investment decisions. The importance of relying on modern techniques by banks in Iraq for the purpose of forecasting profits because of their significant impact on the efficiency and accuracy of forecast results compared to traditional techniques. Using the neural network (NAR) to predict future profits because it is characterized by flexibility and accuracy compared to (LSTM) network. Conducting more studies on the topic of profits forecasting to include other economic sectors.

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