

# Applying Jaya technique in examining the effective factors in the process of Mergers and acquisitions

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## Abstract

The purpose of this article is to investigate and determine the factors affecting integration and acquisition activities in Iran. For this purpose, two hypotheses were determined and the annual data of 30 companies of the Tehran Stock Exchange in the period 2008-2020 were used to test the hypotheses. To test the hypotheses, the neural network method optimized with the Jaya optimization method was used to examine the effect of the studied variables including firm size and growth ability, risk growth, asset return, equity return, and financial leverage. Analysis using neural networks is used to isolate and clarify the effects of each of the studied variables. The analysis of the neural network showed that the three variables, exchange rate, interest rate, and stock price are very important in the process of changes in merger and acquisition activities in the country. Exchange rate fluctuations in particular have a very elastic effect on mergers and acquisitions, indicating that price effects are important in determining the flow of domestic and foreign investment. The stock market index had a positive effect on domestic mergers and acquisitions. Interest rates had a negative effect on mergers and acquisitions.

*Keywords:* Tehran Stock Exchange, Mergers, acquisitions

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## 1. Introduction

Recently, the rapid increase in the number of merger transactions of some Iranian institutions has led to reduced competition and a decrease in the number of related institutions. In other words, these merger transactions are responsible for the formation of large financial institutions and banks in the banking industry. They have identified several factors that are responsible for rebuilding the banking industry. Initially, *M&A* incentives in the Iranian banking industry or other sectors were limited to strengthening and improving the banking system, and initiatives were taken to merge weak

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or loss-making banks into strong and profitable ones. However, over time, these motivations shifted to synergistic production, growth and expansion, and so on.

The results of the surveys vary according to whether the companies involved in the *M&A* process have positive or negative returns. Therefore, based on the results of one or more studies related to companies in different countries, it is not possible to draw a conclusion about the usefulness of the number of transactions for the buyer (the bidder) and target companies, or in other words, it is not possible to Determine the usefulness of transactions for the buyer and their harmfulness to the target companies, or examined whether the target companies had significant abnormal returns. According to several studies, it can be claimed that these transactions do not change the situation before and after the event, whether the buyer loses in the transaction or both parties lose in such transactions, or this type of transaction is merged for the bank. Useful or not. Therefore, the available results obtained by various experimental studies are not conclusive and there is a research gap. Hence, the present study attempts to fill this gap by applying it to the data of the Iranian stock market.

## 2. Research Background

In order to study the changes and developments in the process of integration and acquisition of foreign countries, many studies have been conducted by researchers, including the study of researcher Dian et al. in [4], showed that technological changes (including computers, online banking, mobile banking, and financial deregulation are the driving forces behind the increase in the number of acquisitions in the banking sector. Globalization and liberalization are also among the things that are responsible for merging banks and institutions.

Auerbach and Riches, found that synergies in these transactions and tax benefits could be possible reasons for the rapid increase in transactions [5].

Yang et al. [3] asset creation, increasing market share and improving productivity were reported as factors in merging the two banks. Hence there are many incentives that can initiate a merger agreement between the two banks. The increase in the number of merger transactions in the Indian banking industry is able to draw the attention of researchers to the study of the effects of these transactions before and after on both targets and acquisition banks.

Rahman in [6] reviewed *M&A* process from the perspective of factors affecting this process, these transactions, the success of *M&A* transactions, the impact of this process on the performance of the company, the impact of this process on the performance of competitors, the impact of various factors such as payment method, The type of transaction, the economy under study, etc., the impact of this process on the performance of the buyer as well as the target companies are very popular among researchers. Most empirical studies examine the success of *M&A* transactions in developed countries, and in short, fewer studies are available in developing economies such as Iran. After examining the company's performance during *M&A* events, researchers have found different results that are not conclusive

Making changes in any organization may cause serious changes in the management of organizations due to financial and organizational pressures. When two companies merge during the merger and acquisition process, they will be severely affected by financial, organizational, and even cultural changes. The two merging companies can use change management tests to set goals and develop an acquisition approach to make the most profitable strategic decisions for their organizations and companies [7].

Liu et al. [8] examined the price forecast and the impact of the *M&A* process on the performance and profitability of companies involved in the process using neural network backpropagation and

genetics. One of the main problems of post-diffusion networks and genetics is their early convergence. Apart from the fact that the intelligent genetic method is almost obsolete today, which is only suitable for problems with discrete values, it can not lead to accurate analysis and processing of relationships. Among the variables in the neural network, it is republished and will not provide a high-precision response to predict the impact of the *M&A* process on the company's profitability, hence providing another intelligent method that is superior to genetics and using it to strengthen the network. Nervous can provide more timely responses in this regard.

In [2], the authors examined the identification of the most appropriate merger and acquisition strategy to improve the cooperation of agricultural cooperatives by experts. A multi-criteria decision-making approach based on Analytic Hierarchy Process (AHP) was used to identify and prioritize integration and acquisition strategies. In their study, 16 executive and academic experts active in the field of cooperation were purposefully selected and their opinions were collected in the form of a questionnaire. The results of their studies showed that among the 6 criteria studied to select the strategy of integration and acquisition, the criterion of identifying market needs was the first priority. Also, based on a combination of criteria, horizontal integration and acquisition strategy was the first priority and mixed integration and acquisition strategy was the last priority.

The article entitled "Identifying the grounds for integration and acquisition in cooperatives producing in the agricultural sector of Iran" examined the factors promoting integration and acquisition among agricultural cooperatives. The results showed that agricultural cooperatives are strongly inclined to merge and acquire due to lack of technical and human capacity and consequently decrease in competitive capacity. The increasing need for competitors' control as well as completing the supply chain are other important areas in motivating agricultural cooperatives to merge and acquire [9].

In an article entitled "Explaining the role of merger and acquisition financing sources on the performance of companies based on hierarchical theory" to see the role of merger and acquisition financing sources on the performance of companies on They dealt with the basis of hierarchical theory. This study uses composite data regression on a sample of companies listed on the Tehran Stock Exchange that were acquired by other companies during the years 1391 to 1395, shows that the source of financing the merger and acquisition on performance The company has a different impact. The more the company uses the debt ratio for financing, the more the company's performance changes, increasing the return on equity and decreasing the return on the company's assets. Also, the increase in Sudan and financial leverage as a source of financing has increased the rate of return on assets and performance of the company, but the return on equity and value of the company has not changed [10].

### 3. Research Method

Identifying the factors influencing the *M&A* process helps to determine the impact of this process on the performance and profit and loss of the target companies and the buyer involved in the process, so providing an optimal model that can suggest effective variables in the *M&A* process can be Provides security for buyers and target companies to conduct transactions and adopt this process with less risk. Recently, researchers are interested in using intelligent methods to analyze the relationships between determinants in the *M&A* process [11, 12]. One of the most important and commonly used intelligent techniques is neural networks. Neural networks, by applying random weights to the studied variables, cause them to be mapped on estimation functions in order to analyze the relationships between them [13], so if the random process of applying weights to each variable can be turned into a conscious process and the neural network with more conscious and non-random weights can map the studied variables to estimation functions, then we can have more expectations and more accurate

estimation of the neural network. One way to turn accidents into knowledge (from absolute ignorance to consciousness) is evolutionary optimization methods. One of the new evolutionary optimization methods that are known for its simplicity is the Jaya optimization method. Therefore, in this study, first we try to strengthen the neural network by optimizing Jaya and then using a strengthened neural network to predict the variables affecting the M&A process. Therefore, the present study tries to identify the effective factors in the merger and acquisition of target companies using an empowered neural network with optimization.

### 3.1. Statistical population of the research

Several companies listed on the stock exchange that have been involved in the merger and acquisition process, including the target companies and the buyer in the years 2001 to 2020 have been examined. The variables considered to measure their impact on the merger and acquisition process are corporate performance, capital structure, company size, the extent of corporate risk growth in mergers and acquisitions, and performance.

### 3.2. Research Hypotheses

1. Risk growth variable, growth rate have a positive and significant relationship on the process of integration and acquisition.

2. Company size variables, growth rate have a negative and significant relationship with the merger and acquisition process.

## 4. Technique gone

In 2016, Rao introduced a metaheuristic optimization method called Jaya, which is a new and simple tool to solve various problems dynamically with the evolutionary optimization method. Jaya's optimization is based on this important principle in order to achieve a comprehensive optimal answer. And nationwide, each time the problem is repeated, the set of solutions moves towards a good answer and away from an inappropriate or bad answer each time it is repeated. The main advantage of Jaya optimization can be mentioned in speed, simplicity, and no need for any adjusting parameters. The general process of this method for solving the problem is described below. If  $F(x)$  is the objective function of the problem and we intend to find the maximum or minimum objective function in the problem by Jaya method, then in each iteration  $t$ ,  $n$  there are a number of proposed solutions (i.e. population size  $i = 1, \dots, n$ ). Assume that in iteration  $t$ , the best value obtained from all the candidate solutions for the objective function  $F(x)$  is equal to the value  $X_{best}^t$  and the worst value of the objective function  $F(x)$  is equal to  $X_{worst}^t$ , if  $X_i^t$  Expresses the value of solution  $i$  in iteration  $t$ , then in order to find the optimal answer (solution) in the next iteration ( $t + 1$ ), the decision variable  $X_i^t$  must be changed and updated as follows

$$X_i^{(t+1)} = X_i^t + r_1(X_{best}^t - |X_i^t|) - r_2(X_{worst}^t - |X_i^t|) \quad (1)$$

So  $X_{best}^t$  is the solution with the best value (best answer among all solutions) and  $X_{worst}^t$  is the solution with the worst value (worst answer among all solutions).  $X_i^{t+1}$ , the updated value of solution  $X_i^t$ ,  $r_1$  and  $r_2$ , are two random numbers in the  $i$  iteration that are in the range  $[0,1]$ . The expression  $r_1(X_{best}^t - |X_i^t|)$  indicates that the solution is closer to the best answer, and the expression  $r_2(X_{worst}^t - |X_i^t|)$  indicates that the current solution is moving away from the worst. Is solved and the condition for termination of optimization is to reach the maximum iteration set for the algorithm or not to change the response value of each solution in the desired iteration.

Predicting effective factors in integration and acquisition with neural network and Jaya.

Number of input, hidden and output nerves.

The number of input nerves is equal to the number of independent variables. Since the number of independent variables considered is the same for each data sample, the number of input nerves is equal to the number of independent variables used [13].

Regarding the number of nerves in the hidden layer, it should be said that there is no law to determine the number of nerves in the hidden layer. In general, their number is usually determined by the following formula:

$$n_1 = \sqrt{(m + n) + \alpha}.$$

So  $n_1$  represents the number of hidden layer nerves,  $m$ , the number of input nerves, and  $n$ , the number of output nerves and  $\alpha$ , is an integer between 1 and 10.

## 5. Optimal allocation of weights in the neural network using Jaya technique

Jaya optimization method is used to optimize weights in the neural network to predict the importance of the studied factors in integration and acquisition with a neural network equipped with conscious and stronger weights. In the following, the research method is described in detail to predict the factors affecting the integration and acquisition through the optimized neural network with Jaya.

The neural network is considered to be the error propagation network that tries to optimize its weights using the optimization method.

After determining the number of iterations and the number of solutions in Jaya, first, the initial solutions are generated randomly. In other words, the initial position of each solution is determined randomly, then after obtaining the objective function for each solution, the position of each solution is updated in the next iteration using Formula 1.

### 5.1. Problem modeling

The position of each saw is considered to be a binary string of length  $N$  where  $N$  represents the total number of weights and biases in the assumed neural network. The value of each element in the array represents the amount of weight assigned to each connection. It is then updated each time the position is repeated via Formula 3-1. The weight range  $[-1,1]$  is considered. The total number of weights includes the weights that connect the input layer to the hidden layers and the weights that connect the hidden layers to the output layer, so depending on the number of input, hidden and output layers, the number of weights will vary. Application The number of hidden and output layers is calculated according to the number of input and output properties in the database. The proposed optimization will be performed separately for each intended hidden layer.

### 5.2. Purpose of the issue

The fit function is obtained using formula (1). The accuracy of the neural network is considered as a function of fitness.

Therefore, the steps of the proposed method to solve the problem of weight optimization in the neural network using the Jaya optimization method are defined in the following steps:

1. The maximum iteration and number of solutions in the search space are determined. The initial population of solutions, ie  $X_i, i = 1, \dots, n$  is created. The number of solutions in the initial population according to trial and error is 45.
2. The position of each solution in the search space is determined according to step 3-2-2-1.
3. The suitability of any solution is achieved by using neural network accuracy. Since the position of each solution is equal to the random value of the total weights in the neural network, then by placing the initial random weights in the network, the network is executed and obtains accuracy. Here, network accuracy is considered as the appropriate position of the solution. Therefore, for each

solution available in the population, their suitability, which is equivalent to the accuracy of the neural network, is calculated.

4. The suitability of each solution is calculated.
5. Set the iteration to  $t = 1$ .
6. The position of the solution is selected with the best fit.
7. The position of the solution is chosen with the worst fit.
8. Each solution in the problem space is updated by approaching the best global solution among all solutions and moving away from the worst global solution among all solutions.
9. Arrange the solutions and find the best answer  $x^*$ .
10. If the criterion of repetition  $t$  reaches its maximum value, stop the method, otherwise put  $t = t + 1$  and go to step 4.

The pseudocode of the proposed method is described in Figure 3-1.

Compute Objective function  $f(x)$ ,  $x = (x_1, \dots, x_d)$  [based on section 3-2-2-2]

Initialize the jaya population  $x_i$  ( $i = 1, 2, \dots, n$ ) based on section 3-2-2-1

while ( $t < Max$  number of iterations)

Generate and updating locations / solutions [based on eq.1]

For each solution

Update each solution using gbest and gworst (eq.1)

IF (New solution ( $x_i(t + 1)$ )  $\Rightarrow$  Current locations / solution  $x_i(t)$ )

Select New solution

ELSE

Select a Current solution

End if

End for

Rank the solutions and find the current best  $x^*$

End While

Results a

Figure 1- Pseudocode of neural network method improved with Jaya technique

The pseudocode of the research method for optimizing weights in the neural network is shown in Figure 1. Therefore, the proposed flowchart is described in detail in Figure 2. The purpose of the flowchart chart is to improve the post-diffusion neural network method by using it in the credit risk assessment process. Since the Jaya optimization technique has been used to improve the neural network intelligence method after propagation, first in the first phase it is necessary to determine the solutions in the problem space, after determining the number of solutions in the problem it is necessary to determine the position of each solution, The position of each solution according to section 3-2-2-1 is considered equivalent to weights and biases in the network, in other words, the position of each solution is equivalent to weights and biases in the neural network that is randomly distributed in the form of bits. They are adjusted, so the position of each solution is equal to the total weights and biases in the neural network. After determining the position of the solutions, the initial position of each solution is evaluated. The evaluation of the initial solutions is determined by referring to the fitness function in section 3-2-2-2 in Formula 1, the fitness function refers to the neural network and the path position Gives the desired solution, which includes the weights and biases to be applied to the network, to the neural network whose inputs are equivalent to each merger and acquisition transaction according to the values in Table 1 features. Up to this point,

the initial position was quantified and the position fit of each solution was calculated. Reach the termination condition (the termination condition is expected to reach the maximum repetition or accuracy expected) are updated. How to update the position of each solution in each iteration is achieved by approaching the solution with the global optimum and moving away from the solution with the worst global in Formula 1. After updating each solution, the fitness function is referred to again and the degree of fitness of the position of each solution is selected to decide in order to choose the solution with a better position. The fit function is also the accuracy of the neural network after propagation, the details of this step are discussed in Section 3.2.2.2. The accuracy of the post-diffusion neural network algorithm is also obtained by measuring and matching the values of the indices related to the data sample obtained from the neural network with the values of the indices of the real data samples in the database. At the end of the algorithm and reaching the iteration termination condition, a solution is returned as the response, which is the final response. The position of the obtained solution indicates the optimal weights and biases used in the neural network and its suitability shows the degree of accuracy and results obtained from the neural network to predict the effect of mergers and acquisitions on the performance of the company.

### *5.3. Improved activation function in the neural network*

The activation function in the neural network is very important and is usually expressed as linear and nonlinear mathematical functions. Simply put, the activation function is based on biological neurons (brain neurons) that decide whether a neuron is activated. These functions are very important for learning and understanding relationships within a neural network. Therefore, the function of this function is that each activation function in the network receives a number and then a mathematical operation is performed on the received number and the output of the activation function is a number that is in the range 0 or 1 or in the range 0 to -1. Takes. In this work, the logistic activation function with nuclear weights is considered in Section 3.3.

In the Gaussian core method, more weights are assigned to observations (samples) closer to the  $x$  loan sample and less weights to samples farther from the  $x$  loan sample. The parameter  $h_j, 0$  is called bandwidth, which determines the ratio of local information to partial information used in total.

### *5.4. Prediction of integration and acquisition with improved neural network with Jaya*

The proposed research method predicts the factors affecting the integration and acquisition process using the Jaya-mediated amplified neural network method. In order to carry out the process of the proposed research method, the statistical population of some companies listed on the stock exchange was used. The statistical population used has 10,000 samples of companies' transactions for the merger and acquisition process and 10 indicators. . The 10 important indicators extracted are considered as input features in the neural network. The effect of each of the indicators on the integration and acquisition process is considered as the output of the neural network.

As mentioned earlier, the feeder multilayer perceptron neural network with post-diffusion training is used to train the neural network, and the Jaya optimization technique for applying optimal weights to the connecting lines of input layer neurons to latent layer neurons is mapped. Indicators intended for integration and acquisition transactions into the network and application of activity functions in latent layer neurons in order to predict the impact of the studied indicators on the integration and acquisition process are discussed. The post-release network consists of two parts. The first part represents the forward propagation of information and the second part represents the reverse propagation of error. In forward propagation, the input information is sent to the output through the layers. So that each layer only affects the next layer. If the expected output is not achieved, an

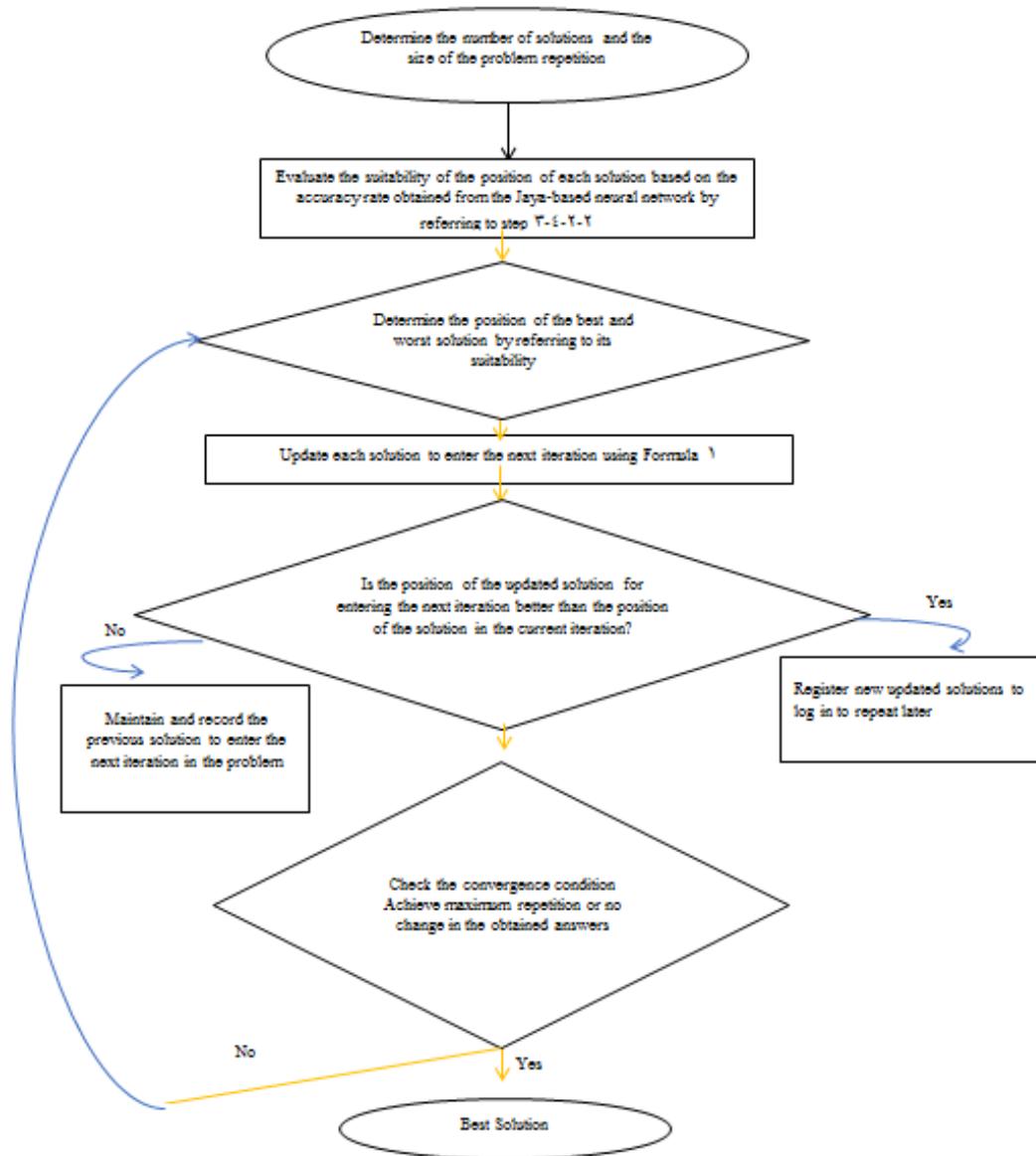


Figure 1:

error will be calculated. The error will be published to the previous layer. Based on the resulting error, the weights and threshold of each layer will be adjusted until it reaches the desired and optimal goal.

The data samples in the database are divided into two parts: training and testing. In the training section, the proposed improved neural network in section 3-5-3 is taught with all sample training data along with class labels. The class tag refers to the probability of loan repayment or the same output feature. More specifically, it can be said that the data sample of the training section uses credit indicators (input features) along with the probability of repayment of each data sample (output feature) for training the improved neural network in section 2-3-3 and the proposed neural network. Teaches then in the test section, data samples without class tags, ie data samples only with the values of financial indicators (input characteristics) and without knowledge of the impact of indicators on the process of integration and acquisition (output characteristics) to network testing To predict the impact of each of the indicators affecting the process of integration and acquisition, using the trained network in the education sector.

Use the k-fold validation model for testing, ie after neural network design on the problem data. So far, many validation methods have been proposed, the most common and most widely used of which is the cross-validation method of k-type (k fold). This validation method is a tool to evaluate the research method, which is based on the separation of data samples into training and testing, so that in this method, the total number of trading samples (data or stock exchange records) is divided into k parts and each The load of one part of k (a folder) is considered as a test sample and the other parts (other folds) are considered as training samples. Therefore, the nature of developing and expanding problems to solve using neural networks is based on the analysis of problem data samples into two parts: training and testing. First, a part of the problem data, which is considered as an educational part, is designed and trained with a designated neural network. Then, it is designed to test the neural network and predict the expected responses from the sample data considered as The test section is used, in other words, to predict the response of a new sample or the same test sample is referred to the designed or trained network on the training data to obtain a predictive response. Data samples refer to the shares of each company bought and sold, so that the shares of each company bought and sold also contain the characteristics of the range of independent variables that are described in Table 1. The data samples are divided into two parts: training and testing. In the training section, the proposed improved neural network in section 2-3-2 is taught with all the training data samples along with the response variables, meaning the response variable (dependent), probability The effect of each factor or the same as the output feature, more clearly we can say that the data of the education department of the studied variables that are expected to be effective in applying the strategy of integration and acquisition, along with the probability of impact of each of the studied variables (Output feature) is used to train the neural network and trains the proposed neural network. The probability of impact of each of the studied variables (dependent variable) is network testing to predict the probability of impact for each sample of the transaction under review in the company, using the network trained in the training department.

To investigate the effect of the studied variables on the process of merger and acquisition of companies listed on the OTC market, the hypotheses presented in the research opportunities section are tested using the smart neural network method. In the issue raised in this article, the factors under consideration or those factors that we are trying to measure their impact on the methods of integration and acquisition, as an independent variable and the impact of each of them on the process of integration and acquisition as a variable.

Dependent  $r$  (response) is considered in the neural network. The independent variables of the problem in neural networks are known as nerves in the input layer and the response variable of the

problem under study is known as the nerves in the output layer. Therefore, the number of nerves in the input layer and the output layer is determined based on the current information of the problem. For example, if the effect of two variables on the merger and acquisition strategy is to be measured, then the neural network contains two nerves in the input layer and one nerve (response or dependent variable, which here indicates the type of influence (positive or negative) on merger and acquisition). Is in the output layer. Since the purpose is to examine the impact of several variables to assess their impact on the merger and acquisition and measure the performance of companies, then performance appraisal is based on the analysis of several variables, so there are several independent variables, each in turn Analysis of each of the response variables (type of impact on the merger and acquisition method and company performance).

Table 1: Independent Variables in the Studied Neural Network

Variable name	Concept
ROE <sup>*</sup>	Return on equity: the ratio of net profit after tax and priority in receiving dividends in the investment funds of company i in period t
ROA <sup>†</sup>	Return on assets = the ratio of net profit after tax to total assets of the company (book value of assets) i in period t
TDA <sup>‡</sup>	Financial leverage control variable = the ratio of total debt to total net assets of company i in period t
SIZE <sup>§</sup>	Company size control variable = the natural logarithm of total assets of company i in period t
GRO <sup>**</sup>	Growth control variable = annual changes in trading turnover .. Number of traded shares of company i on the total number of traded shares of company i in period t
RISK <sup>††</sup>	Company risk control variable: is obtained from the standard deviation of company asset return i in period t
EA <sup>‡‡</sup>	Exclusive assets of the company. Because mergers and acquisitions are positively related to asset monopoly (Cording et al., 2002), the ratio of intangible assets to total assets has been chosen to measure the firm's monopoly assets.
Firm growth ability	The ability to grow the company. The motivation for faster growth of the company is usually one of the important factors that play a role in increasing the demand for mergers and acquisitions, which usually also improves the company's performance.

\* Return on Equity

† Return on Assets

‡ Leverage = the ratio of total debts to total net assets

§ Firm size

\*\* Growth

†† Firm risk

‡‡ Exclusive assets of the firm

## 6. Research Findings

In this section, the implementation of the research method is examined and its findings are analyzed. The performance of the proposed research method is evaluated.

### 6.1. Square averaging error

The relative and absolute error mean method is used to evaluate the suitability of the proposed neural network method in predicting the factors affecting integration and acquisition.

Mean square error: Calculating this error is a method of estimating the amount of error, which is actually the difference between the estimated values and what is estimated. The error of mean squares is positive almost everywhere (not zero) for two reasons: one is that it is random, and the second is because the estimator does not count the information that can produce a more accurate estimate. So this index, which always has a non-negative value, the closer it is to zero, the lower the error rate. Therefore, this error is used to measure the strength and efficiency of the neural network method proposed in the research method to predict the impact of some factors on the integration and acquisition processes. According to the formula, for each acquisition, the difference between the predicted factors and the real factors is calculated for different time periods and then added together and reaches the power of 2. In other words, the calculation of the criterion of the mean square error is obtained from the square of the total difference between the predicted factors and the studied factors for different considered time periods.  $n$  is the number of acquisition transactions per company.

$$\text{Mean squared error} = \frac{1}{n} \cdot \sum_{x=1}^n |t_{px} - t_{ox}| \quad (2)$$

Since the application of neural method tests requires various settings, including hidden layers, it can be said that the error rate of predicting factors using the neural method is strongly dependent on the number of hidden layers in the neural network and the values of the weights connecting the layers to each other. Binding weights were obtained by optimal and conscious values using a simple and modern metaheuristic method, but trial and error experiments were used to adjust the hidden layers, trial and error, and factor prediction testing for different layers. 5 layers to 20 layers were performed, after examining different values for the hidden layer, the results showed that the 18 hidden layers were suitable for prediction, so that at first in the 5 hidden layers, the network prediction error obtained a significant amount. And after that, by adding to the layers, the forecast error rate was gradually reduced and we witnessed a decreasing trend of the forecast error, so that until reaching 14 hidden layers, the forecast error rate was reduced and after that, from 15 Hidden layers Up to 20 hidden layers, no change in error rate was achieved, meaning that the hidden layer prediction method 18 has reached convergence. Therefore, the analyzes performed by the neural method with different settings show a low prediction error rate for 18 hidden layers.4.

## 6.2. Validation of neural network prediction performance by regression test

Another way to measure and validate the performance of the proposed neural prediction method is to apply regression tests on such networks; therefore, by performing regression tests on the prediction made with the neural network, the network performance was validated. The results of regression analysis of the proposed neural optimal pattern are shown in Figure 2. Also, the average value of the correlation between the predicted output and the actual data sample is about  $R = 0.83$  and close to 1, and this shows the high accuracy of the proposed method in predicting and identifying the factors affecting integration and acquisition. On the other hand, the reason for obtaining the appropriate value for the  $R$  parameter can be sought in the optimal setting of weights, since one of the factors affecting the appropriate value of  $R$  is the application of weights and biases to the neural network in the best possible way, it can be concluded that The simple and modern metaheuristic optimization method used in Section 3-4 in order to improve and optimally adjust the values of the weights connecting the layers to each other in the neural network, had a successful performance in optimizing and applying appropriate weights and biases to the network.

This study examines the performance of companies merged and acquired in the stock exchange in the period 1392 to 1398 using indicators of growth, size, company risk, growth ability. For this purpose, information about transactions made using corporate financial statements and using Fold 10 validation test, the results of the hypotheses that the financial risk and operational risk of companies

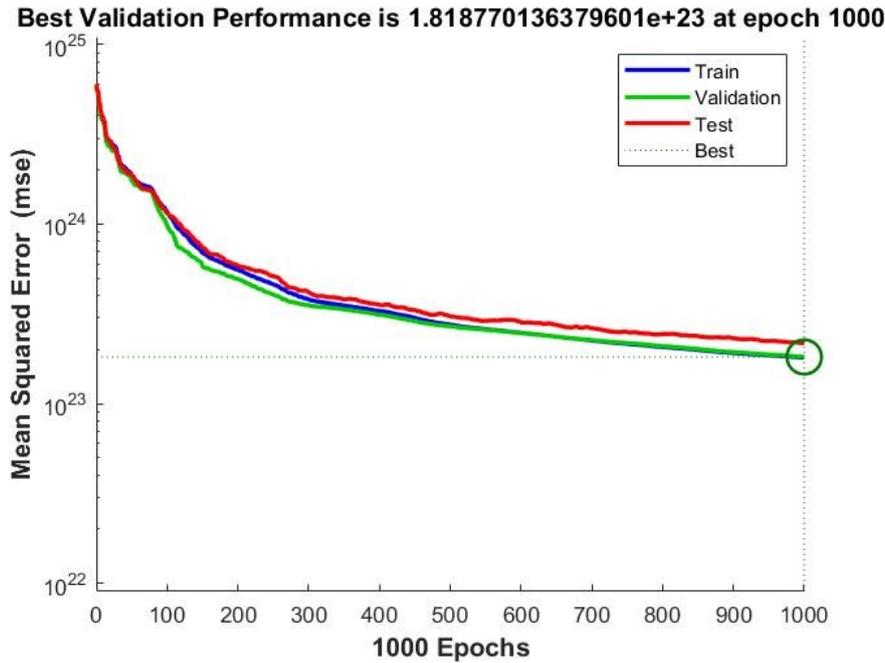


Figure 2: Diagram of average square error .. Sepah Bank

after the merger and acquisition ratio are significant. In the previous period, the increase and decrease and the growth of the company increased, respectively, and had a positive effect on the performance of the acquired and merged companies. The results show the increase in the financial risk of the acquired companies after the acquisition, among which Only the increase in relation to fixed assets to total debt was significant and the increase in other indicators was not significant.

### 6.3. Turbulence matrix

Figure 3 shows the turbulence matrix of the outputs categorized by the research method for the variables of firm size and risk growth. As shown in the figure, the rows represent the output class and the columns represent the actual classes used. Diameter cells represent those specimens that are correctly classified. Non-diagonal cells also represent observations (samples) that have been misclassified. The number of samples and the percentage of total samples in each cell are shown. The end column to the right of the matrix represents the percentage of predicted samples belonging to each class that are correctly and incorrectly categorized, usually to these percentages, the positive predictive rate and the false discovery rate They also say. The first row at the top of the matrix represents the percentage of all samples in each class that are correctly or incorrectly categorized, which is usually called true positive and false negative. As can be seen from the figure, in the validation section of the method (test) for Class 1, all merger and acquisition transactions belonging to Class 1 except 10 samples (transaction) are correctly predicted, and in the case of samples belonging to Class 2, 43 samples are incorrectly categorized. The following figure shows the turbulence matrix for all data samples (including training and test samples) and their predictions.

## 7. Conclusion

Due to the importance of merger and acquisition processes, increasing the number of target companies and the lack of proper management of target companies and buyers in terms of measuring

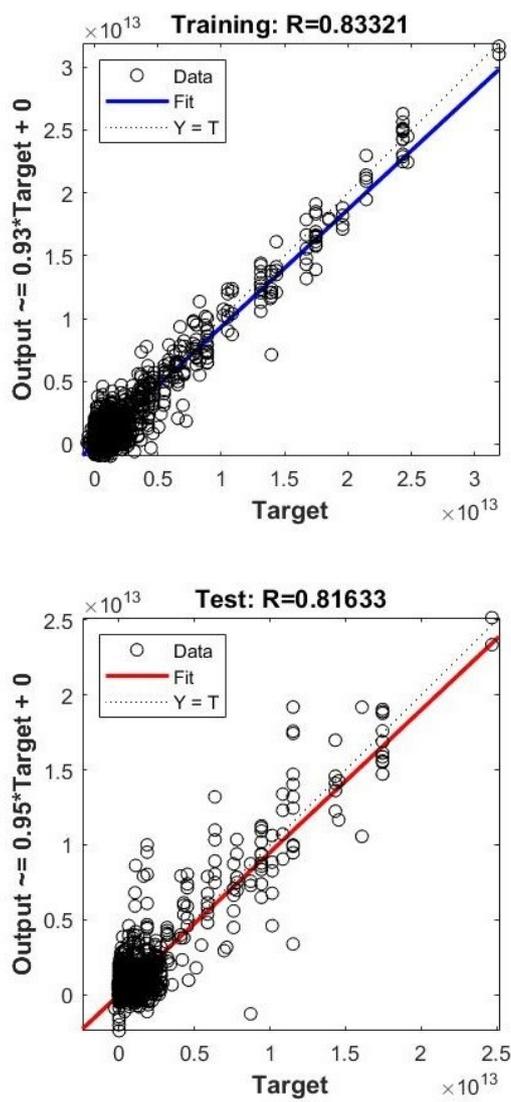


Figure 3: Regression analysis diagram on neural network prediction

**Training Confusion Matrix**

Output Class	1	<b>1314</b> 86.6%	<b>95</b> 6.3%	<b>93.3%</b> 6.7%
	2	<b>30</b> 2.0%	<b>79</b> 5.2%	<b>72.5%</b> 27.5%
		<b>97.8%</b> 2.2%	<b>45.4%</b> 54.6%	<b>91.8%</b> 8.2%
		^	v	
		<b>Target Class</b>		

**Test Confusion Matrix**

Output Class	1	<b>470</b> 86.6%	<b>43</b> 7.9%	<b>91.6%</b> 8.4%
	2	<b>10</b> 1.8%	<b>20</b> 3.7%	<b>66.7%</b> 33.3%
		<b>97.9%</b> 2.1%	<b>31.7%</b> 68.3%	<b>90.2%</b> 9.8%
		^	v	
		<b>Target Class</b>		

Figure 4:

the profits and losses of the company, etc. can face serious challenges for owners and shareholders of target companies and buyers. Various factors can be effective in identifying the success of the acquisition and merger of a company and thus reduce the risk of not managing the company's financial performance and low profitability and high risk. These factors include financial leverage, company size, corporate growth, corporate risk, corporate equity, corporate ownership and financial wealth, corporate governance, equity rate of return, asset rate of return, book value to market value ratio Is the total assets of the company, the total liabilities of the company, the stock price in the last transaction.

By observing the prediction results obtained from the improved neural network method, it has a high performance in predicting the factors affecting integration and acquisition. The predicted accuracy is more similar to the learning examples than the proposed powerful neural method. Some of the output data samples are not clear in the learning sample in the results of the regression method but are evident in the improved neural network method. This means that the improved method improves the simulation capability of the conventional neural network method. Sample data of each company, including profit and loss statements of each company, cash flow, transactions made by each target company should not be processed by the same neural method.

In the following, the hypotheses of the article are analyzed and proved.

Hypothesis 1: The risk growth variable has a significant positive and significant effect on the integration and acquisition process.

Analysis of the results of regression analysis and validation of neural network prediction performance showed that all variables have a positive and significant relationship with company performance and are effective in company profitability and therefore each in turn has a significant and positive effect on They have a merger and acquisition process, so according to the research findings confirm the first hypothesis based on the positive and significant effect of growth variable on the merger and acquisition process because the risk growth variable in the merger and acquisition process increases the profitability of listed companies. Securities have been secured.

Hypothesis 2: Company size factor has a significant negative and significant effect on the process and performance of listed companies. Findings from the research show that this hypothesis is rejected because all the factors studied in the research method, each in turn is involved in the process of integration and acquisition and has increased the company's performance, and therefore it can be said that all factors studied in Research methods and findings have been effective in the process of integration and acquisition.

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