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# The Modeling and Prediction of Stock Prices in the Mining Industry in Tehran Stock Exchange

Omid Amandad[1,*], Hossein Seyfi Ghobadi[2], Forough Baharlooyi[3], Raza Hoseinipour[4]

[1,2] M.A, Department of Accounting, Ferdowsi University of Mashhad, Mashhad, Iran
[3] M.A in Accounting, Institute for higher education ACECR, Khouzestan, Iran
[4] M.A, Department of Accounting, Ferdowsi University of Mashhad, Mashhad, Iran

## ABSTRACT

**Financial and economic issues, especially capital markets is one area that is important in today's forecast. Future trend of prices prediction to adopt appropriate strategies for buying or selling is the main goal in these markets. Various techniques exist to predict future stock prices. Fundamental analysis is one method that considers several variables. In this paper, neural network model (RBF) and econometric panel data are used to increase efficiency, reduce costs and time in fundamental analysis. For this purpose, a sample of 17 companies over a period of 7 years (2005-2012) of listed companies in Tehran Stock Exchange are selected in the coal mining industry, mining and other mining, metal ore mining and other non-metallic mineral products. The results indicate good accuracy in modeling to predict the stock price on the Stock Exchange and subset of industries. Also, comparing the accuracy of econometric panel data pattern with neural networks in forecasting stock price represents the neural network has higher precision.**

## KEYWORD

**fundamental analysis, prices stock prediction, RBF, panel data, coal mining industry.**

*Corresponding Author: Omid Amandad
E-mail: omidaman.kh1@gmail.com
Telephone Number: +98 9155622616

## INTRODUCTION

Short-term planning in various fields for survival and persistence of activity of economic entities and effective investment and financing decisions is necessary for managers, investors, users and creditors. We can have a good reaction by planning before encountering the adverse economic events. It is necessary to improve the ability to predict accurately and consistently to increase the effectiveness of programs. Because the prediction is a key element in decisions of users within the organization and outside the organization. Therefore, efficient and effective decision would be made on the basis of correct predictions [1]. In general it can be said that the predictions is estimating future forecasts and the goal of predicting is reducing risk in decision-making. Predictions are not usually correct and have some errors, and this amount is reduced by having more information about the system. The predictive value means to the use of this information in the process of predicting. In finance the information such as stock prices, profits, returns on equity, bankruptcy and risk can be predicted. Among these, forecasting of stock price is important, because they are the factors that effect on activists decision on NYSE stock prices. The existence of related information forms basic transactions in the capital market and therefore information is the most valuable assets in capital market [2]. The main goal in these markets is to predict the future trend of prices to adopt appropriate strategies for buying or selling. However, the stock market is not affected only by the macro parameters, but another important factor effect on it [3]. There are too many unknown factors affecting the market, causing uncertainty in the investment market. Uncertainty is inevitable for investors who have chosen to invest in the stock market. So, investors naturally try to reduce this property, given that the understanding of behavior and the

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methods of stock prices movement in the market and the ability to predict are one of the tools for reducing uncertainty in this market, as a result, investors are looking for ways to better assess and predict stock prices and earn the highest return on their investment. Various techniques exist to predict future stock prices. One method that considers several variables, is fundamental analysis [4].

Each country had its own form of capital market structure models are not universality available. Also according to the research, the majority of countries are poor in terms of the efficiency of capital markets. Therefore, only in long-term times the prices are independent of each other and in the short term, it will be very much dependent. In fundamental analysis it is believed that changes in stock market are unpredictable and the behavior of stock prices is formed in accordance with the theory of random walk (Exact date not repeatable). Several factors affect the stock price. Some of these factors are economic variables and some of the variables include: financial ratios, industry conditions, and more. Analyze economic, industry and company should to be combined to predict future stock prices using fundamental analysis. In fundamental analysis the forecasts are based on the facts and real events. Trader analyze real-world events and news based on knowledge and strategies to deal with market forecasts [5]. The basis of fundamental analysts is that all changes in prices has probably a financial-fundamental reason and believe that the actual intrinsic value of securities can be obtained. According to pave the way for private investment in the mining sector, there has been a growth in the mining industry, therefore, investors can use the potential to invest in these industries to improve efficiency, and by predicting stock prices, the companies in this industry, decided to invest more appropriate to take stock. Achieving economic growth and improving investment incentives requires an active and reliable capital markets in developing countries. This is possible through the absorption and distribution of capital and financial resources in the sector of industry [6].

In the past decade the financial forecasts in accounting and finance has been the subject of much research .For instance, forecasted earnings per share, stock price, earnings management, financial ruin, etc. [7]. Much research have been taken in this area using statistical approaches and artificial intelligence approaches. Among the methods used, the traditional statistical methods highly dependent on assumptions such as linearity, normality, independence of predictor variables and etc [8]. Previous research shows that the neural networks have predictability more than the statistical model [9] [10] [11] [12]. Also, if two or more models are then combined, the likelihood of achieving the best prediction increases [13]. In addition to neural networks, econometric models are used to estimate and prediction. Time series data, cross-sectional data, panel data are these methods. Among these panel data is one of econometrics methods that that each day the desire to do it in the scientific studies expanded [14]. Given that stock prices are one of the variables influencing investment decisions, managers and creditors, it is expected this group use advanced techniques such as artificial neural network and use panel data to predict stock prices. In this study, the panel data and artificial neural network RBF (econometric model) are used to increase effectiveness, reduce costs and fundamental analysis.

## THEORETICAL ISSUES

With the development of financial markets and an increasing amount of information, participants in financial markets are looking for tools which can make precise predictions of the future state of market with them. With a review of previous research on forecasting in capital markets, predict models can be classified into four groups:

1. Technical Analysis
2. Fundamental Analysis
3. Econometrics
4. Intelligent Techniques

In this research the combination of fundamental analysis, intelligent forecasting and econometric (panel data) will be examined.

Fundamental analysis is based on the assumption that stock prices does not reflect all information with respect to time and is in search of information that do not reflected in the current stock price and, therefore, predict a future price adjustment. Because market prices in the future move to the basic values [15] [16].

Potential predictions often focuses on economic forecasts, because the uncertainty in this area has the most importance in order to determine investment risk and return. One of the most important tools in fundamental analysis is the use of econometric models. These estimates are usually obtained from historical data, but sometimes they may not be able to work well in the future and forecasts are weak .In the case structural reforms in these relationships must be established. Another tool that is used in this analysis is the Company's financial statements that has been designed by the management, accountants [17].

After the crisis, October 19, 1987, in the stock market, increasing attention was diverted to the existence of a nonlinear relationship in the marketplace and especially erratic market movements. According to the theories in the group, dynamics in the market and erratic behaviors that to be random were considered. Because these movements are able to build larger and more complex movements. In 1988, for first time Halbet White presented the application of neural networks in economic forecasts. In this study, the value of neural network in prediction of nonlinear models are presented that codes the stock market opened using this technique.

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### PANEL DATA

The panel data consist of the time series data and cross-sectional data. It means the information regarding cross sectional data can be observed over time. Such data have two dimensions, which one dimension is related to a variety of units at any given time and another is related to the time. In time series data the values of one or more variables are observed over a period of time (for example GDP over the past few years). In cross sectional data the value of one or more variable are collected at the same time for a single data or a sample (for example the stock price for the 50 companies listed in a given year). But in panel data, the same cross sectional units (for example, a specific industry) are measured at the time [18].

### THE ADVANTAGES OF USING PANEL DATA

Since panel data should be homogeneous, therefore, there is limited variance anisotropy in this model. By combining time-series and cross-sectional observations, panel data provide more information, more flexibility, greater efficiency and greater degree of freedom. Panel data provide items that can't easily be observed in time-series and cross-sectional data. Panel data is better to study the dynamic changes. Panel data enable us to study more complex behavioral models. In general it should be said the panel data enable a rich form for empirical analysis which if you use the time-series or cross sectional data it is not possible [18].

### RBF NEURAL NETWORK

Research and interest in artificial neural networks began when the brain as a dynamic system with a parallel processing architecture is completely inconsistent with the known conventional processors. In 19th century, William James proposed stacks change attitudes about the physiological and brain structure. Among them may be noted in brain neurons and mechanisms for parallel processing. Function Networks are Radial Basis from the family of forward neural networks. These networks introduced for the first time by Bromhid & Low in 1998. RBF network with a variety of applications is one of the most popular neural networks and is main competitors for multilayered Persporon network. This method is different from other method due to forms of training, the function of neurons and hidden layers. This method always use a hidden layer, where it is not necessary to determine the number of hidden layer of neurons; because it is responsible for the network itself. The most of RBF networks can be trained in shorter times than the time required for the training of feed forward networks. A unique feature of this network is the process that performed in the hidden layer. Input layer send the input value to each of the nodes in the hidden layer. Each node in the hidden layer (neurons) are characterized by a transfer function $f$ that transfer the input signals.

For p th input pattern, means XP, the answer for j th hidden node means yj is equal to (Eq 1):

$$y_j = f\left\{\frac{\|X^P - U_j\|}{2\delta_j^2}\right\} \quad (1)$$

Where $\|X^P - U_j\|X$ is equal to the Euclidean form, Uj is center of hj th for radial basis function, and δ is the range of RBF, which indicator is radial distance from the center of RBF and in that particular function value is not zero.

Learning algorithm in the middle layer radial basis of neural network calculates the distance between input vectors with neurons centers and according to which neuron has the minimum distance to the input vector and will choose the winner neuron. The centers of these neurons moves to the input vector. In neural networks with radial basis, function of activity of the middle layer neuron usually assumed Gaussian (Eq 2).

$$f_{(x)} = \frac{1}{\sqrt{2\pi}}\exp\left[\frac{-x^2}{2}\right] \quad (2)$$

The output of a network is obtained using a weighted linear sum of responses to each of the nodes in the hidden layer output. The output of K th nodes in the output layer, ie $Z_{pk}$ be calculated from the following equation [21] (Eq 3).

$$Z_{pk} = \sum_{j=1}^{L} y_j w_{kj} \quad (3)$$

Where L is the number of neurons in the middle layer and $W_{kj}$ is weights link between the hidden and output nodes. The learning algorithm is a supervised algorithm to output layer that change weight coefficients based on the minimum mean-square (LMS). In the criteria LMS, it will continue to change weight coefficients that the mean square error (MSE) minimizing for all training packages. In other words, criteria LMS, in the every stage of education, MSE will desire into its minimum [20].

### RESEARCH BACKGROUND

In the literature, fundamental analysis and econometric model for panel data are not presented.

### INTERNAL RESEARCH

Botshekan (2000) used an artificial intelligence technique called neural networks - Fuzzy (ANFIS) for predicting stock price in Bahman company and assessed the ability this model in comparison to linear models (ARIMA).also box - Jenkins method is used to determine ARIMA model. Input variables are the price index, latest stock prices, trading volume and the price of oil. The results show superiority of Network - Neuro-Fuzzy (ANFIS) in predicting the stock price relative to the linear model (ARIMA) [21].

Accourding to Nazarian et al (2013) research and regards to the development of financial markets and the importance of these markets and the close relationship with macroeconomic variables the use of advanced mathematical models with complex structures to predicting the market is

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quite acceptable. In addition, the neural network model in comparison to other advanced models due to its high accuracy have special place, so predict volatility of stock index in Tehran stock Exchange using the daily data of stock price index between 03/25/2009 to 22.10.2011 and the reducing model with the potential long-term memory, forward neural network model and also the combination of two model. The results reflect base on the evaluation criteria of prediction error, although, the feed forward neural network model has a smaller error than the reducing model with the potential long-term memory. But the accuracy of combined model is higher than either of these two models alone [13].

### EXTERNAL RESEARCH

Schumann and Lohrbach (1993) predict the next day stock price in Frankfurt market by Arima and artificial neural network models. They have used the 13 given daily data for 9 years. The data is the type of technical data, also they have used an artificial neural network with two hidden layers. As a result we can't prefer these two methods together [22].

Feransesko & Rakesh (2012) provided a model for the predicting volatility in stock market belonging to the five founding members of the Association of Southeast Asian Nations as ASEAN-5, using the model of asymmetric APARCH with the two different distribution T-Student and GED, the aim was identify the symmetry or asymmetry in the relationship between stock returns and market volatility in ASEAN-5 market. The used data in the model were from indigenous companies of the stock market on January 2, 2002 to January 30, 2012 and are included financial turnover and the value of traded stock. The results represent superiority APARCH model and the t distribution using the prediction measurement error [23].

Peter, Vladimir and Renata (2013) predict the stock price with considering the quantitative data and hidden feelings (lack of assurance in reports and related terms) in the annual report and using nervous network and regression method. The used data include profitability ratios and technical analysis variables is collected from companies listed in the United States in 2010. The results showed that nervous networks provide better results especially when we consider hidden feelings in annual reports [7].

## RESEARCH METHODOLOGY

### RESEARCH GOAL

In this study, the econometric model for panel data and neural network RBF are used to increase efficiency, reduce costs and fundamental analysis. So the main aim of the study is examining the accuracy of econometric model and neural network (RBF) to predict the stock price and the main question is:

Do forecast accuracy of stock prices using fundamental analysis and neural network (RBF) in the mining industry is higher than the econometric model?

### RESEARCH HYPOTHESIS

The forecast accuracy of stock prices using fundamental analysis and neural network (RBF) in the mining industry is higher than the econometric model?

### POPULATION

The population is listed companies in the Tehran Stock Exchange for the mining industry during the years 2005 to 2012 that data for this study are available.

### SAMPLING METHOD

The sampling method are in this form that the companies that have not the following conditions are removed:

1 – The firms are accepted in the Tehran Stock Exchange before 2005.

2 - In the period of the study, the fiscal year have not changed.

3- The sample companies have the basic financial statements for the years 2005 to 2012.

After applying the above cases 17 companies were selected.

### COLLECTING DATA METHODS AND TOOLS

The required information and data for this study has been collected using the information in the database from the Tehran Stock Exchange (Tadbirpardaz & Rahavardeh novin). The necessary information to analyze the economic situation collected from the Central Bank database. TOPSIS method is used to check the status of the industry.

### DATA ANALYSIS METHOD

In this study, the econometric model for the panel data and RBF neural network are used to predict the stock price. Thus, in this section to the variables and used data, the analysis of implementation algorithm methods and evaluation criteria of models.

### RESEARCH VARIABLES

As previously noted, in the fundamental analysis, first investors analysis and the market and economy as a whole to realize the best time for investing. Then they analysis some of the industries or economy whose future prospects are good. Finally, if the analyst conclude that the investment is appropriate and appropriate industries with high efficiency work in the economy cycle, they focus on firm analysis. The impact of the economic indicators on the industry has been studied through inflation based on the consumer index, exchange rate in open market, oil earning, volume of money

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and coin rate. Industries are ranked each year using TOPSIS methods and variables used for analysis of company include: Current ratio, quick ratio, current debt to equity ratio, debt to equity, debt to assets ratio, interest coverage ratio, quick asset turnover ratio, current assets turnover ratio, tangible fixed asset turnover ratio, gross profit margin, operating profit margin, net profit margin, return on equity, return on assets, the ratio of price to earnings, ratio of book value to market value ratio, price to book value ratio, price to sales, book value of equity , return on equity, total current assets, total liabilities, earnings per share. Factor analysis was used to determine the most influential variables. In the factor analysis, the variables that have a correlation above 0.5 were in the one group and based on the eigenvalues calculated for each group combining variables were obtained [24].

In Table 1, the correlation between the variables used to calculate combining variables is presented. After determining the variables that have a correlation above 0.5 in a group, eigenvalues must be calculated to obtain combining variable. The matrix of eigenvalues which is obtained using EVIEWS7 software are shown in Table 2. The matrix of eigenvalues is multiplied by in the matrix variables that have high correlation and combining variables (PC s) is obtained.

Combining variables are as following:

PC1: total of current asset, total of debt

PC2: Current debt to equity ratio, debt to equity ratio, return on equity

PC3: quick asset turnover ratio, current assets turnover ratio

PC4: book value, current ratio, quick ratio, tangible fixed asset turnover, return on assets

PC5: the ratio of price to book value, gross profit margin, operating profit margin, net profit margin, earnings per sha

Tab.2. Eigenvalues of combining variables

| Combining variables | Variable | Eigenvalues |
|---|---|---|
| PC1 | Total of current assets | 0/8575 |
| | Total of debt | 0/1425 |
| PC2 | The ratio of current debt to equity | 0/969 |
| | The ratio of debt to equity | 0/0228 |
| | Return on equity | 0/0082 |
| PC3 | Immediate asset turnover ratio | 0/9038 |
| | current asset turnover ratio | 0/0962 |
| PC4 | Book value | 0/5928 |
| | Current ratio | 0/2055 |
| | Immediate ratio | 0/1304 |
| | Tangible fixed assets turnover ratio | 0/0555 |
| | Return on asset | 0/0159 |
| PC5 | Price to book value ratio | 0/7058 |
| | Gross profit margin | 0/1691 |
| | Operational profit margin | 0/0954 |
| | Net profit margin | 0/0247 |
| | EPS | 0/0051 |

Source: Computing Research

**TOPSIS algorithm used in industry rankings**

Step One - normalizing decision matrix: in this step, we change the scale in decision matrix to no-scale. In this way, each of the values are divided to the value of vector. Consequently, each element rij is obtained from the following equation (Eq 4):

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^{2}}} \quad (4)$$

The second step - the weighting to normalized matrix: in reality the decision matrix is parametric and it is necessary to be quantitative. , For this purpose decision maker defines the weight of each index. So that ND is a matrix where rates of indexes change to ((no Scale)) and comparable and Wn * n is a diagonal matrix whose only elements of its original diameter are non-zero.

$$W = \{w_1, w_2, \ldots, w_n\}$$

$$V = N_D.W_{n*n} = \begin{vmatrix} v_{11} & v_{12} & v_{1j} & v_{1n} \\ v_{21} & v_{22} & v_{2j} & v_{2n} \\ v_{m1} & v_{m2} & v_{mj} & v_{mn} \end{vmatrix}$$

Step Two - Determine the ideal solution and negative ideal solution: Two virtual item A * and – A are defined as follows:

$$A^{+} = \{(\max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J') \mid i = 1,2,\ldots,m\} = \{v_1^{+}, v_2^{+}, \ldots, v_j^{-}, \ldots, v_n^{+}\}$$

$$A- = \{(\min_i vij \mid j \in J), (\max_i v_{ij} \mid j \in J') \mid i = 1,2,\ldots,m\} = \{v_1^{-}, v_2^{-}, \ldots, v_j^{-}, \ldots, v_n^{-}\}$$

$$J = \{j = 1,2,\ldots,n \mid j \in \text{benefit}\}$$

$$J' = \{j = 1,2,\ldots,n \mid j \in \text{Cost}\}$$

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Tab.1. The correlation between variables to calculate the combining variables (factor analysis)

| | PS | SER 01 | SER 02 | SER 03 | SER 04 | SER 05 | SER 06 | SER 07 | SER 08 | SER 09 | SER 10 | SER 11 | SER 12 | SER 13 | SER 14 | SER 15 | SER 16 | SER 17 | SER 18 | SER 19 | SER 20 | SER 21 | SER 22 | SER 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PS | 1.00 | 0.11 | 0.13 | 0.00 | 0.39 | 0.09 | 0.76 | -0.36 | 0.67 | 0.36 | 0.24 | -0.08 | -0.03 | -0.29 | -0.52 | 0.23 | 0.17 | 0.55 | 0.33 | 0.30 | 0.33 | -0.04 | 0.12 | 0.69 |
| SER 01 | 0.11 | 1.00 | 0.71 | -0.01 | -0.08 | 0.11 | 0.24 | -0.11 | 0.05 | -0.01 | 0.05 | -0.03 | -0.01 | -0.14 | -0.24 | 0.02 | 0.03 | -0.06 | 0.32 | 0.34 | 0.28 | -0.05 | -0.11 | 0.10 |
| SER 02 | 0.13 | 0.71 | 1.00 | 0.02 | -0.11 | 0.03 | 0.28 | -0.07 | -0.01 | -0.26 | -0.24 | 0.01 | 0.00 | 0.26 | -0.19 | 0.25 | 0.21 | -0.21 | 0.18 | 0.20 | 0.13 | -0.09 | -0.34 | 0.01 |
| SER 03 | 0.00 | -0.01 | 0.02 | 1.00 | -0.03 | -0.01 | 0.00 | -0.01 | 0.12 | -0.04 | -0.07 | 0.06 | 0.05 | 0.08 | 0.07 | 0.00 | -0.04 | 0.00 | -0.11 | -0.10 | -0.12 | 0.03 | -0.05 | -0.09 |
| SER 04 | 0.39 | -0.08 | -0.11 | -0.03 | 1.00 | -0.03 | -0.07 | 0.14 | 0.13 | 0.59 | 0.37 | -0.04 | 0.04 | -0.31 | -0.07 | -0.07 | -0.20 | 0.43 | -0.08 | -0.14 | -0.07 | -0.02 | 0.06 | 0.36 |
| SER 05 | 0.09 | 0.11 | 0.03 | -0.01 | -0.03 | 1.00 | 0.13 | -0.11 | 0.13 | 0.05 | 0.15 | -0.04 | -0.02 | -0.15 | -0.02 | -0.12 | -0.13 | 0.09 | 0.32 | 0.32 | 0.28 | -0.05 | -0.12 | 0.06 |
| SER 06 | 0.76 | 0.24 | 0.28 | 0.00 | -0.07 | 0.13 | 1.00 | -0.44 | 0.49 | 0.05 | 0.06 | 0.06 | 0.07 | -0.16 | -0.36 | 0.39 | 0.38 | 0.23 | 0.43 | 0.40 | 0.41 | 0.08 | 0.07 | 0.51 |
| SER 07 | -0.36 | -0.11 | -0.07 | -0.01 | 0.14 | -0.11 | -0.44 | 1.00 | -0.26 | -0.11 | -0.16 | 0.13 | 0.15 | 0.16 | 0.20 | -0.10 | -0.17 | -0.14 | -0.40 | -0.41 | -0.38 | 0.10 | -0.07 | -0.29 |
| SER 08 | 0.67 | 0.05 | -0.01 | 0.12 | 0.13 | 0.13 | 0.49 | -0.26 | 1.00 | 0.25 | 0.18 | -0.05 | -0.01 | -0.19 | -0.32 | 0.02 | -0.04 | 0.43 | 0.23 | 0.23 | 0.21 | 0.00 | 0.13 | 0.40 |
| SER 09 | 0.36 | -0.01 | -0.26 | -0.04 | 0.59 | 0.05 | 0.05 | -0.11 | 0.25 | 1.00 | 0.86 | -0.16 | -0.06 | -0.58 | -0.13 | -0.21 | -0.31 | 0.74 | 0.14 | 0.08 | 0.07 | -0.03 | 0.29 | 0.36 |
| SER 10 | 0.24 | 0.05 | -0.24 | -0.07 | 0.37 | 0.15 | 0.06 | -0.16 | 0.18 | 0.86 | 1.00 | -0.17 | -0.06 | -0.65 | -0.16 | -0.43 | -0.33 | 0.60 | 0.37 | 0.33 | 0.31 | -0.08 | 0.14 | 0.37 |
| SER 11 | -0.08 | -0.03 | 0.01 | 0.06 | -0.04 | -0.04 | 0.06 | 0.13 | -0.05 | -0.16 | -0.17 | 1.00 | 0.97 | 0.25 | 0.06 | 0.00 | -0.04 | -0.08 | -0.08 | -0.07 | 0.03 | 0.96 | 0.04 | 0.19 |
| SER 12 | -0.03 | -0.01 | 0.00 | 0.05 | 0.04 | -0.02 | 0.07 | 0.15 | -0.01 | -0.06 | -0.06 | 0.97 | 1.00 | 0.09 | 0.02 | -0.03 | -0.06 | -0.04 | -0.02 | -0.01 | 0.10 | 0.93 | -0.02 | 0.25 |
| SER 13 | -0.29 | -0.14 | 0.26 | 0.08 | -0.31 | -0.15 | -0.16 | 0.16 | -0.19 | -0.58 | -0.65 | 0.25 | 0.09 | 1.00 | 0.21 | 0.13 | 0.09 | -0.36 | -0.51 | -0.44 | -0.45 | 0.15 | -0.09 | -0.34 |
| SER 14 | -0.52 | -0.24 | -0.19 | 0.07 | -0.07 | -0.02 | -0.36 | 0.20 | -0.32 | -0.13 | -0.16 | 0.06 | 0.02 | 0.21 | 1.00 | -0.05 | -0.09 | -0.32 | -0.30 | -0.33 | -0.29 | 0.02 | -0.13 | -0.46 |
| SER 15 | 0.23 | 0.02 | 0.25 | 0.00 | -0.07 | -0.12 | 0.39 | -0.10 | 0.02 | -0.21 | -0.43 | 0.00 | -0.03 | 0.13 | -0.05 | 1.00 | 0.81 | 0.04 | 0.02 | 0.03 | -0.03 | 0.08 | 0.33 | 0.12 |
| SER 16 | 0.17 | 0.03 | 0.21 | -0.04 | -0.20 | -0.13 | 0.38 | -0.17 | -0.04 | -0.31 | -0.33 | -0.04 | -0.06 | 0.09 | -0.09 | 0.81 | 1.00 | -0.05 | 0.08 | 0.14 | 0.08 | 0.05 | 0.36 | 0.18 |
| SER 17 | 0.55 | -0.06 | -0.21 | 0.00 | 0.43 | 0.09 | 0.23 | -0.14 | 0.43 | 0.74 | 0.60 | -0.08 | -0.04 | -0.36 | -0.32 | 0.04 | -0.05 | 1.00 | 0.17 | 0.16 | 0.16 | 0.07 | 0.50 | 0.62 |
| SER 18 | 0.33 | 0.32 | 0.18 | -0.11 | -0.08 | 0.32 | 0.43 | -0.40 | 0.23 | 0.14 | 0.37 | -0.08 | -0.02 | -0.51 | -0.30 | 0.02 | 0.08 | 0.17 | 1.00 | 0.97 | 0.88 | -0.07 | -0.09 | 0.52 |
| SER 19 | 0.30 | 0.34 | 0.20 | -0.10 | -0.14 | 0.32 | 0.40 | -0.41 | 0.23 | 0.08 | 0.33 | -0.07 | -0.01 | -0.44 | -0.33 | 0.03 | 0.14 | 0.16 | 0.97 | 1.00 | 0.91 | -0.05 | -0.04 | 0.53 |
| SER 20 | 0.33 | 0.28 | 0.13 | -0.12 | -0.07 | 0.28 | 0.41 | -0.38 | 0.21 | 0.07 | 0.31 | 0.03 | 0.10 | -0.45 | -0.29 | -0.03 | 0.08 | 0.16 | 0.88 | 0.91 | 1.00 | 0.03 | -0.08 | 0.58 |
| SER 21 | -0.04 | -0.05 | -0.09 | 0.03 | -0.02 | -0.05 | 0.08 | 0.10 | 0.00 | -0.03 | -0.08 | 0.96 | 0.93 | 0.15 | 0.02 | 0.08 | 0.05 | 0.07 | -0.07 | -0.05 | 0.03 | 1.00 | 0.29 | 0.26 |
| SER 22 | 0.12 | -0.11 | -0.34 | -0.05 | 0.06 | -0.12 | 0.07 | -0.07 | 0.13 | 0.29 | 0.14 | 0.04 | -0.02 | -0.09 | -0.13 | 0.33 | 0.36 | 0.50 | -0.09 | -0.04 | -0.08 | 0.29 | 1.00 | 0.31 |
| SER 23 | 0.69 | 0.10 | 0.01 | -0.09 | 0.36 | 0.06 | 0.51 | -0.29 | 0.40 | 0.36 | 0.37 | 0.19 | 0.25 | -0.34 | -0.46 | 0.12 | 0.18 | 0.62 | 0.52 | 0.53 | 0.58 | 0.26 | 0.31 | 1.00 |

Source: Computing Research

Two virtually created options are the worst and the best solution.

Fourth step - obtaining measurements of distances: distance between each alternative N-dimensional is measured by Euclidean method. It means the interval option I is calculated from the ideal options of positive and negative.

$$d_{i+} = \{\sum_{j=1}^{n} (v_{ij} - v_j^{+})^2\}^{0.5}; i = 1, 2, \ldots, m$$

$$d_{i-} = \{\sum_{j=1}^{n} (v_{ij} - v_j^{-})^2\}^{0.5}; i = 1, 2, \ldots, m$$

Step Five - calculating the relative closeness to the ideal solution: This criteria is obtained by the formula (Eq 5):

$$cl_{i+} = \frac{d_{i-}}{(d_{i+} + d_{i-})}; 0 \le cl_{i+} \le 1; i = 1, 2, \ldots, m \quad (5)$$

If Ai=A+ so di+=0 and we have cli+=1 and if Ai=A- so di-=0 and cli+=0.

Thus any size Ai option is closer to ideal solution (A +) , so cli+ is closer to one.

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Step Six - Rating Options: finally, options are ranked according to the descending order.

In this method, in addition to considering the distance of Ai from the ideal point, the distance from the negative point to be considered. That means that the selected option must have a minimum distance from the ideal solution and yet have the farthest distance from the negative ideal solution. In this method, the option m are evaluated by n indexes. Every problem can be viewed as a geometric system consisting of m points in an n-dimensional space.

Infrastructure fact of this method is:

A – Desirability of each criteria should be steadily increasing (or decreasing) so available value of an indicator represents the ideal position and the worst value of that specifies the negative ideal.

B – the distance of an option from ideal may be Euclidean distance or is calculated as the sum of the absolute value from linear distance (known as block distance), that this depends on the exchange rate and replacement between index.

In order to classify industries using TOPSIS, the variables such as return on equity, return on assets, EPS, P / E, stock return, current ratio, debt-equity ratio, operating profit margin and net profit margin are used. After using this method, mining industry, among the 10 industries classified on the Stock Exchange during the years 1384 to 1390 were ranked as follows in Table 3.

Tab.3. Ranking the industry using TOPSIS method

| Year | 1384 | 1385 | 1386 | 1387 | 1388 | 1389 | 1390 |
|---|---|---|---|---|---|---|---|
| ranking | 4 | 1 | 7 | 9 | 3 | 6 | 2 |

Source: Computing Research

## ALGORITHM USING PANEL DATA

Panel data model can be demonstrated as follows (Eq 6):

$$y_{it} = \alpha_{i0} + \alpha_1 x_{1it} + \alpha_2 x_{2it} + \cdots + \alpha_k x_{kit} + \varepsilon_{it}$$
$$\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it} \quad (6)$$

And here M_i and λ_t are imperceptible effects of individual and time respectively and ν_it is residual for error component and in the matrix will be as follows (Eq 7):

$$y = \alpha_{NT} + X\beta + \varepsilon \quad i = 1, \ldots, N \;\; t = 1, \ldots, T$$
$$\varepsilon = Z_\mu \mu + Z_\lambda \lambda + \nu \quad (7)$$

To implement for econometric model of panel data EVIEWS7 software is used.

## NEURAL NETWORK ALGORITHM

After extracting the data must be processed, so that the data in the database were recorded partially removed. The related toolbox in the Clementine software is used to implement the neural networks algorithm. It is required to split data into training data and test data to use the toolkit. For this purpose, 80% of data were selected for training and 20% for testing. Then data categorized in order to be application in software, then, the main process of modeling is done; this means that by using neural network technique, patterns and relationships between data (independent variables and the dependent variable) are extracted. In this step the training data are used to modeling. After obtaining the modeling between data, the precision of constructed model is estimated by using experimental data, and finally, error criteria are used to check the accuracy of model. The used RBF neural network consist of an input layer (3 neurons), the middle layer (1 to 20 neurons) and output layer (1 neuron).

In Figure 1 the method used to complete the process is shown.

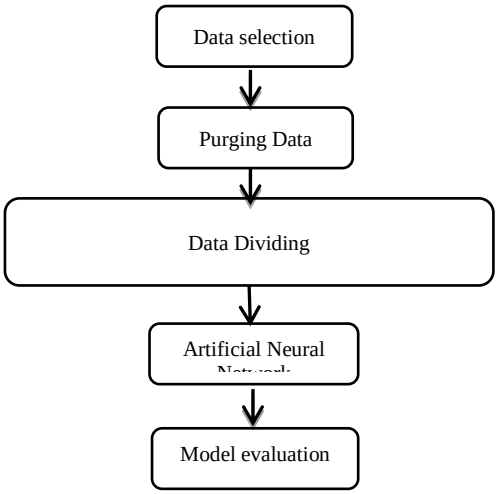


Fig.1. The process of Neural Network

After factor analysis and making appropriate and meaningful patterns the combining variable PC4 (book value ratio, current ratio, quick ratio of tangible fixed asset turnover, return on assets) and SER08 (stock return) were significant as accounting variables in fundamental analysis using panel data econometric model. Significant economic variables of hypothesis model are the price index of consumer goods and services in urban areas.

Tab.4. Descriptive statistics

| Model | Inf | SER08 | PC4 | PS |
|---|---|---|---|---|
| number | 91 | 91 | 91 | 91 |
| Mean | 181/7000000 | 32/4716348 | 1328/528180 | 5820/9670 |
| Median | 183/3000000 | 12/3354298 | 850/1749899 | 4006/0000 |
| Mode | 110/40000 | 2/01119 | -340/20096 | 7218/00 |
| S.D | 55/71330581 | 66/84846029 | 1152/684937 | 5949/20279 |
| variance | 3103/972 | 4468/717 | 1328682/563 | 3539301/79 |

Source: Computing Research

Table 4 shows the descriptive statistics of the variables in the model hypothesis, including: PS (stock price), and Pc6 (book value ratio, current ratio, quick ratio, tangible fixed asset turnover, return on assets) and SER08 (stock return). Stock price is dependent variable and other variables are as independent variables. In this table, number represents the observations for each variable, the mean represents the mean of observations for each variable, median reflects the moderate of observations, mode represents the highest frequency of observations for each variable, the standard deviation represent the deviation of the observation from the mean and variance is squared deviations from the mean of observations. To test for normality, standard error of

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skewness coefficient and Standard Error of Kurtosis are used. If the values of the indices are smaller than 2 - or greater than 2 +, the normality is rejected [25]. The results in Table 5 indicate that the variables are normally distributed.

Tab.5. Standard error test

| Model | Inf | SER08 | PC4 | PS |
|---|---|---|---|---|
| Number | 91 | 91 | 91 | 91 |
| standard error of skewness coefficient | 0/253 | 0/253 | 0/253 | 0/253 |
| Standard Error of Kurtosis | 0/500 | 0/500 | 0/500 | 0/500 |

Source: Computing Research

## LINEARITY

A situation that indicates an independent variables is a linear function of other independent variables. If the linearity in regression is high, it means that there is a high correlation between the independent variables and although it seems to be a good model, but it has no significant independent variable. To detect linearity two factors of variance inflation factor and tolerance were used. The minimum amount that can be a get variance inflation is one and this is in the situation that there is no linearity between the independent variables, whatever the value of this factor is greater than one, indicate better linearity between the independent variables. Also, linearity is serious when the amount of variance inflation factor is greater than 10. Regarding the variance inflation factor values in Table 6, the linearity between the independent variables is very few and the tolerance level is greater than 0.4, which is good [25].

Tab.6. The linearity between independent variables

| Model | | tolerance | Variance inflation factor |
|---|---|---|---|
| Independent variable | PC4 | 0/961 | 1/040 |
| | SER08 | 0/902 | 1/109 |
| | Inf | 0/935 | 1/069 |

Source: Computing Research

Table 7 represents the mean residual is zero, which is underpinned by assumptions of regression.

Tab.7. Statistical indexes in relation to the anticipated residual values

| | Number of observation | S.D | mean | Max | min |
|---|---|---|---|---|---|
| Predicted Value | 91 | 4175/12615 | 58209670 | 23312/4902 | -592/7353 |
| Residual | 91 | 4238/08158 | 0/00000 | 18605/42969 | -10873/45996 |
| The Predicted standardized value | 91 | 1/000 | 0/000 | 4/189 | -1/536 |
| Standardized residual | 91 | 0/938 | 0/000 | 4/316 | -2/523 |

Source: Computing Research

After considering the assumptions on the regression and preparing variables to build a model for selecting between integrated model and fixed effects model, the Chow test and for selecting fixed effects or random in panel data model Hausman test is used. This test has an asymptotic chi-square distribution and degrees of freedom is equal to the number of explanatory variables (regression). According to the probability column in Table 8, the results of Chow test indicates panel data model is used. Hausman test is provided for selecting between random and fixed effects.

Tab.8. Test F Chow

| Hypothesis | Distribution | statistic | Degree of freedom | the probability |
|---|---|---|---|---|
| | F | 5/923473 | (75,12) | 0/0000 |
| | Chi-square | 60/667678 | 12 | 0/0000 |

Source: Computing Research

Table 9: hausman test

| Hypothesis | Statistic | Degree of freedom | the probability | the result |
|---|---|---|---|---|
| | 7/034364 | 3 | 0/0708 | Fixed effects |

Source: Computing Research

According to the column of Table 9, the probability is less than 0.5, so fixed effects model is accepted. According to results, the stock price modeling by considering panel data model with fixed effects is summarized in Table 10.

Tab.10. stock price modeling

| Variable | The estimated coefficient | statistic t | probability |
|---|---|---|---|
| C | 4113/548 | 3/092439 | 0/0028 |
| PC4 | 2/121075 | 4/199973 | 0/0001 |
| SER08 | 38/66953 | 6/473727 | 0/0000 |
| INF | -13/02230 | -1/979698 | 0/0514 |

$R^2$ = 0/739453 $\overline{R}^2$ = 0/687343 $F$ =0.000

Durbin Watson statistic= 1.665831

Source: Computing Research

As you see in above table, Note that the column probability is less than 5% for all variables, so all variables are significant and the model is suitable. The coefficient of determination represents the number of 0.739453, which represents the power produced to justify the model, it means the dependent variable is explained by the independent variables by 74%; 74% change in the stock price depends on selected variables in the model. Also the calculated probability of F-statistic is less than 5%, so the model is valid. According to the value of Durbin- watson statistic (between 1.5 and 2.5), the assumed correlation between errors is rejected, so the selected model for predicting is valid.

Price Stock=4113/548+2/121075*PC4+38/66953*SER08-13/02230*INF+ε

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Tab.11. Comparison of the models accuracy

| | | The type of error | | |
|---|---|---|---|---|
| | | RMSE | MAE | MAPE |
| model | Neural Network RBF | 1026/211 | 629/466 | 13/976 |
| | econometric model of Panel data | 3019/970 | 2047/672 | 53/193 |

Source: Computing Research

After construction the appropriate model to predict stock prices, according to the prediction error criteria the research hypothesis were examined. As can be observed in Table 11, the criteria of RBF neural network is less than the econometric model. Therefore, the research hypothesis (higher RBF neural network accuracy in comparison to econometric model in forecast stock price in the mining industry) is confirmed.

## CONCLUSION AND RECOMMENDATIONS

Prices stock prediction in the exchanges can be considered one of the most important issues that facing by stakeholders. In this paper the stock price of coal mining industry, mining and other mineral extraction, steel and other non-metallic mineral were predicted using fundamental analysis and econometric model for panel data and artificial neural network RBF. Considering that fundamental analysis requires large volumes of information and time to learn all the basic elements, and often is costly and time consuming for split investors, thus, the econometric model for panel data and artificial neural network RBF were used to increase effectiveness, reduce costs in fundamental analysis methods. In the literature related to fundamental analysis the use of econometric models for panel data have been neglected to predict stock prices. The variables in selected models include, Pc4 (book value ratio, current ratio, quick ratio, tangible fixed asset turnover, return on assets), SER08 (return on equity), INF (inflation) were significant and determination of coefficient in model represents the power of a good justification of the model; also, the results of prediction in both models indicate a higher accuracy of (RBF) neural network into econometric model which is consistent with previous studies in the field of neural networks. Finally according to results, the selected model is proposed to help investment decisions.

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