

Prediction stock price using artificial neural network (Case study: chemical industry firms accepted in Tehran stock exchange)

Ali SORAYAEI^{1,*}, Zahra ATF², Masood GHOLAMI³

¹ Department of management, Babol aranch, Islamic Azad University, a.sorayaei@gmail.com

² Master of Management, lecturer of Payam Noor University, Atf.zahra@yahoo.com

³ Student of Master of Management, parsugan@yahoo.com

Abstract

The present paper aims to provide an efficient model to predict stock prices using neural networks is. Therefore the chemical industry companies accepted in Tehran Stock Exchange for the study were selected. Data for the period 2014 - 2010 prepared by using feed forward neural network with back-propagation algorithm to predict the stock price of the study were discussed. To evaluate the effectiveness of neural networks as compared to the classical methods of prediction, a comparison with regression (panel data) was performed. Both methods artificial neural network and regression results are consistent with But the total square error of neural network method is 0.29 and 1.68 in the regression that demonstrate the advantages and effectiveness of the neural network method than regression in predicting stock prices and chemical industry companies are listed on the Tehran Stock Exchange.

Keywords: Tehran stock exchange stock price forecasting, artificial neural network, Regression.

1. Introduction

Stock exchange is considered as important tools of capital market that play a special role in economic growth and provides a suitable field to improving economical situation through decreasing risk, pricing, mobilizing and optimum allocating resource and capital [1]. The important feature of stock exchange, in one hand, is a significant passageway of supply financially project with long-term investment and on the other hand, is a reference for collecting private sector's saving and cash.

Holders of dull saving can search for relatively a suitable and safe place for investment and invest their additional funds for buying companies stock or take advantage through buying bonds from defined and warranted benefit.

Previously, classic method had been used to predicting stock price. On this basis in many decades, the mathematical method including simple mean, balanced mean, double mean, regression and were samples that were approved decisively, but often they had limitations. Despite this stock market is a nonlinear system that has been subjected on political, economical and psychological situation. Thus it is so difficult using classic method to accurately decision-marketing on stock exchange transaction. There is so many hopefulness with developing non-linear methods such as neural network, phase nervous networks and genetic algorithm, particularly when a suitable relationship between data and independent variable being non-identifiable [2]. Thus it is tried to partly reduce confusion due to unreliability available in stock market and it's price using prediction method including regression and neural network, and also transform stock exchange market in to a safe place to investment and gaining maximum outcome. From middle 70's and particularly from 1980, spread effort on predictability of stock prices new mathematical methods, long-term time series and more sophisticated tools such as artificial intelligence, and many tests was conducted on price information and stock index at countries like UK, America, Canada, Germany and Japan, to represent the existence or lake of a certain structure for stock price information, through which the hypothesis of random steps being violated [3]. There is no more studies on predicting future situation of stock price using modern prediction methods (artificial neural network and).

Thus it is felt the necessity of performing research.

2. Research Background

2-1) Theoretical background

As we know, stock exchange market is a component of financial market and is considered as a part of its subordinate economic setting ; and we know also that as in such market, there is no rational relationship with other part, it lead to some problems and limitations on its performance. Recession and improvement of stock exchange market not only will influence on national economy, but also global economy [4].

On reliable stock exchange across the world, various indexes have been accounted for analyzing the performance of such stock exchanges. The first used index on stock exchange is “stock price index”.

The most important difference in various indexes is “giving importance” on some special variables including the number of firms or volume of transactions in such indexes. Stock price index always has been influenced by macro economic variables like exchange rate and..... In various periods, in turn would influence on economical stagnation and improvement of stock exchange. The index on total term means representative or illustrative. Index is a quantity which is representative of some harmonious variable and is a tool to measure and compare events that have certain nature of property on which the changes occurred on certain variables in a period of a cycle, could be studied. Until 1988, there was no index on Tehran stock exchange. Later, after that, Tehran stock exchange as other worldwide stock exchange markets, took an action to prepare index using laspeyers formula. Index is a representative of capital market situation, and also reflect the country economical situation in which reduction means recession (crisis) and increase means economic improvement [5].

In general, today's, many attentions have been given to indexes, because through them, total return or price of market could be measured and compared them with other portfolio returns. Also in much case, stock price represents market expectance of firm's economic situation and investment return of such market along with other investing opportunities on land, building, gold, exchange and others ... is comparable through studying movement trend of stock exchange market. In this relation, P_{it} stand for stock price of firm I at time t and P_{i0} and q_{i0} are price and share number of i 'th firm respectively at first cycle of acceptance on stock exchange market. [6]

$$TEPLEX = \sum \dots * 100 \quad (1-2)$$

Where, P_{it} = I 'th firm price at time t

q_{it} = number of distributed share of I 'th firm at time t

D_t = Basic number at time t which equals $\sum P_{i0} q_{i0}$ at origin time.

N = number of included firms of index

Factors influenced on stock price index are categorized to total two class based on William Sharp model:

A) Internal factors (micro-factors): includes those factors which are out of company and some influence on company activity . Such factors can be studied in the frame of political factors and economic factors. [6].

Total stock index has properties following as : [7]

A) Rhythmical: That is, as for calculating it , stock value multiplies by the number of distributed stock, then any changes on stock price based on the number of firms distributed stock influence on indexes, namely more number of firms distributed stock, the influence of change of considered stock price on index is more.

B) Comprehensive: Considering that this index is calculated based on stock change of all accepted companies on stock exchange market, thus it could be referred as a comprehensive index.

C) Accessible: Total price index, considering that, is calculated and accessible for people momentarily through stock exchange market thus has accessibility aspect.

2-2) Research background

Chiang Hong (2005) on his paper titled by” phase-neural combined learning model to predict stock price “, tries to reform ellipse-shaped phase system on accepting time series data to predict stock price. Thus he applies a combined

learning method to speed up supervisory learning process. Finally, neural network “BPNN” is used to compare the prediction precision. Experimental results of 10 companies show that present model has higher precision than BPNN model.

Watada (2006), on his paper named by “structural learning of neural network to predict stock price” tries to create optimally a neural network through structural learning. Such method is applied to predict the weight of stock price. Network optimization using structural network is evaluated based on its real usage. In order to select stock among important stock, much stock was selected from various industries and time series data of their stock price were categorized based on some (self-organized model). Results showed that obtained model enable decreasing and calculations time and also accessing to a simpler structure.

Wang (2007) on his research has used new asymmetric hybrid genetic method at artificial neural network for pricing model, in order to optimally predict the network for prediction of stock exchange price. He concluded that new hybrid model can decrease considerably random error and nonlinearity of stock market to predict stock exchange price.

3. Research methodology:

3-1) Collecting data

Generally, there is no certain direction to determine number of data required for using in neural network models. Through select and combine several idea and by the help of considered society properties and information availability, data related to all chemical industry companies that composed of 30 companies (Paksan, Petrochemical Abadan, Petrochemical Isfahan, Iran Amlah Madani, , Petrochemical Pardis, herbicide poisons, Carbin Iran, producing raw material and artificial fibers, Sina Chemical industry, Polyachril, Iran chemical industry, Pars Pamchal, Kirmanshah Petrochemical industry, Shiraz Petrochemical, Loabiran, Doode Sanati Pars, Fars chemical industry, Goltash, Henkel pakoosh, Sanati Rangin, Investing Petrochemical industry, Pars International production, Niroo colour, Fanavaran Petrochemical, Tolipers, Farabi Petrochemical, Khark Petrochemical and Shaznd Petrochemical), have been used to modeling from 2010 to 2014, from total 150 data, 70% data used to training network and remaining 30% to test. Information related to companies financial statements were extracted and collected from codal.ir site.

3-2) Select and collect the model:

3-2-1) neural network and prediction model:

In this study, raw data has been used to training in design the model; because the normalization result in long training process it sigmoid functions. To modeling prediction using neural networks, A suitable software (Neuro solution) has been used. Then, considering the variability of accessible models and experimentally of network architecture design, various different kind of network with different input number and different architectures of network, number of different elements within hidden layers of network were defined and regard to some of square error, compared together.

To training network, “Generalized feed forward network” with one hidden layers and 3 elements has been used. To determine number of hidden layer elements, as mentioned in Kolmogroof case number of maximum $2n+1$ hidden element is necessary to adequate training network. Sigmoid non-linear function with 2000 repletion has been used for this reason. On neural network method, first data from 2010 to 2014 was considered as training setting, then, after training network and minimizing training error, data of 2014 used as attest setting. Data was ordered on software Excel and placed on suitable software to network architecture.

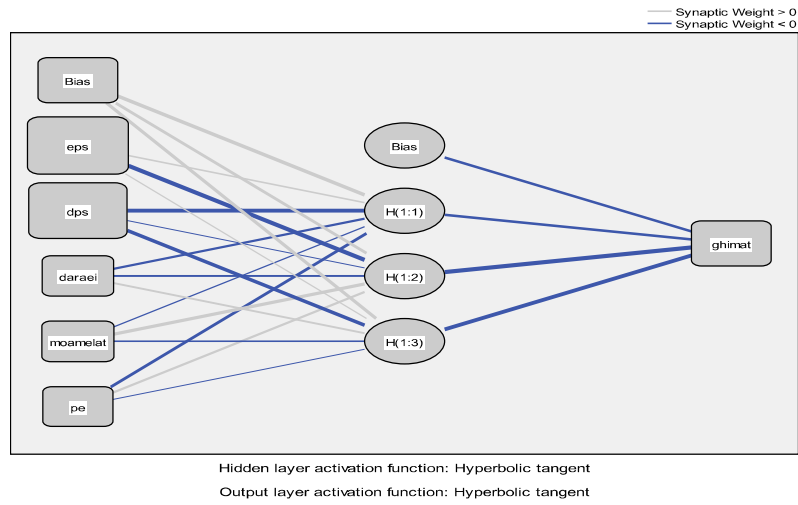


Figure 1: Whole illustration of network architecture.

As seen in figure 1, network includes 5 input variables that enter on hidden layer of a layer through Sigmund function. Then it leads to predict stock price again by Sigmund mathematical function. Lastly, parameter is estimated by network as follow:

Table 1: Estimating parameters

Predictor		Predicted			Price
		Hidden Layer 1			
		H(1:1)	H(1:2)	H(1:3)	
Input Layer	(Bias)	0.344	0.254	0.342	
	EPS	0.102	-0.550	0.095	
	DPS	-0.530	0.043	-0.364	
	NA	-0.159	-0.147	0.118	
	Vs	-0.055	0.272	-0.106	
	P/E	-0.260	0.204	-0.044	
Hidden Layer 1	(Bias)				-0.216
	H(1:1)				-0.233
	H(1:2)				-0.690
	H(1:3)				-0.366

At next step, network draws the diffusion diagram:

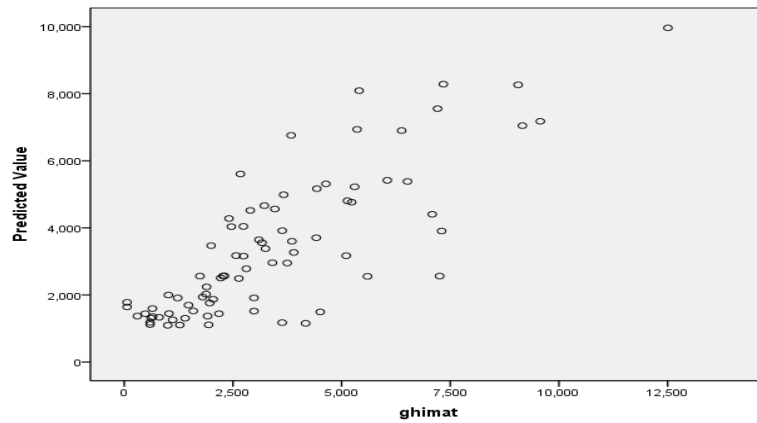


Figure 2: Diffusion diagram of predict stock price

This picture represent how predict values and real values of stock price are diffused. After this phase, sun of square error being calculated:

Table 2: Sum of square error (testing & training)

Training	Sum of Squares Error	1.83
	Relative Error	0.41
	Stopping Rule Used	1 consecutive step(s) with no decrease in error
	Training Time	00:00:00.015
Testing	Sum of Squares Error	0.29
	Relative Error	0.21

Dependent Variable: Price

a. Error computations are based on the testing sample.

According to table, sum of square error for training and test is 1.83 and 0.29, respectively.

Following picture show steps of prediction mean stock price of chemical industry companies to achieve minimum error.

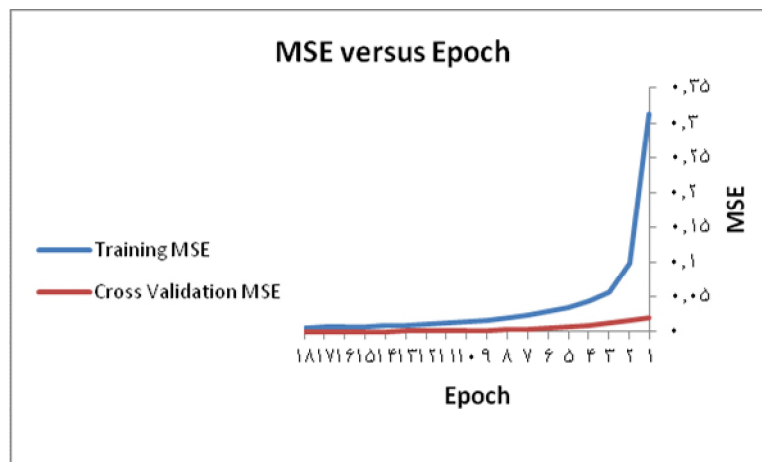


Figure 3: Results of training neural network

As figures 3-4 represents, error in epoch 18 has reached to its minimum that is 0.05%. Diagram illustrates an approximately symmetric of real price and predicted price of stock.

Table 4: Predicting level of variables effectiveness.

<i>Best Networks</i>	<i>Training</i>	<i>Cross Validation</i>
Epoch	18	18
Minimum MSE	0.0059	0.0001
Final MSE	0.0059	0.0001

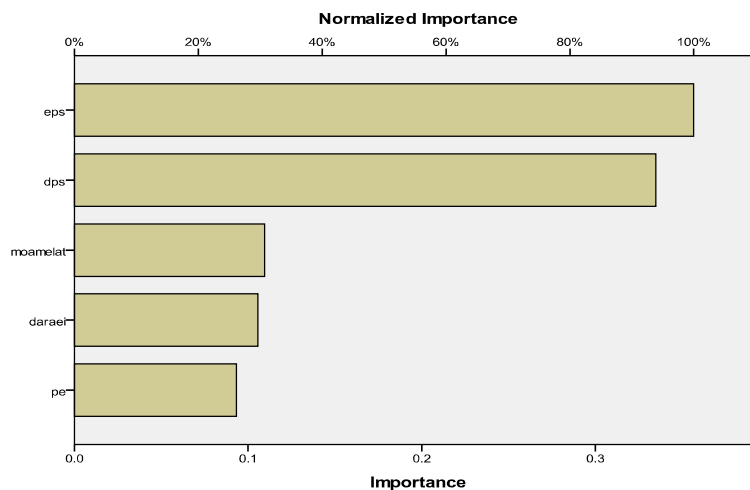
Table 5 show result of average square error of training neural network. As it is seen on table, training has been conducted successfully and amount of average square error in “single-layer feed forward network” has decreased to 0.0059.

Then, this software predict amount of effectiveness of each variable of stock price at future years. Results of this calculation have been represented at table 4.

Picture 5: Diagram of variables effectiveness level.

	Importance	Normalized Importance
EPS	0.357	100%
DPS	0.335	93.9%
NA	0.106	29.6%
Vs	0.110	30.7%
P/E	0.093	1.26%

This information represent in following picture framework through network:



Among research variable, EPS and DPS have influence more than 50% and have significant relationship with stock price to predict it, but Vs and NA and PIE have influence less than 50% and have no significant relationship with stock price

3-2-2) Regression model and prediction

Multi-variable regression model used in this study is “panel data”.

Panel data analysis is an analysis of long-term and linear data which increasingly applied social and economical science researchers. A panel is a sample of cross-sectional or group society of data which have been analyzed periodically and repeatedly in certain duration. 150 data of 30 considered companies are ordered in software Excel and placed on suitable software (Eviews).

Following linear regression model has been used to investigate relationship between research financial variables and stock price:

$$Y_i = B$$

in which independent and dependent variables are:

Y=stock price index of chemical industry companies

$$y_i = \beta_0 + \beta_1 EPS_{it} + \beta_2 DPS_{it} + \beta_3 NA_{it} + \beta_4 (P/E)_{it} + \beta_5 V_{s_{it}} + \varepsilon_{it}$$

EPS=profit of per share

DPS=divided profit of each share

NA=net asset

P/E=ratio of stock price to profit of each share

V_s=volume of stock transaction

E=error coefficient

H₀=There is no significant relationship between financial variables and stock price of chemical industry companies accepted in Tehran stock exchange.

H₁: There is a significant relationship between financial variables and stock price of chemical industry companies accepted in Tehran stock exchange.

$$\begin{cases} H_0 : & \beta=0 & \text{prob} \geq 0.05 \\ H_1 : & \beta \neq 0 & \text{prob} < 0.05 \end{cases} \quad (2-3)$$

To select between fix effects test and combine model "test f" was used. Regard to result of "combined model and fixed effect" test and approving H₀, combined model was selected as a suitable model. Introduced model has performed using "combined generalized last squares method" with panel method. Result show that EPS and DPS variable have been P-value less than 0.05 and are not significant variables.

Totally, summary of research model for relationship between independent and dependent variables are as:

$$Y = 1362.8 + 0.66 EPS_{it} + 2.99 DPS_{it} + 9.71 NA_{it} + 3.27 V_{s_{it}} - 1.76 (P/E)_{it} + \varepsilon_{it} \quad (3)$$

Watson Doorbin statistic is 1.74 which shows lack of self-coordination on error component or a limitation in the model equals with 1.68.

4. Conclusion and suggestion:

Considering the significance of independent variable used in the study relative to dependent variable, both methods of neural network and regression are compatible with each other.

At it is observed, some of square error in neural network method and regression method is 0.29 and 1.68 respectively, which is illustrative of priority and efficiency of neural network method against regression method to predict stock price of chemical industry companies accepted in Tehran stock exchange; also it suggests that prediction with artificial neural network provide chemical industry companies with a more acceptable and suitable than regression method.

Regard to research results, following suggestions is provided:

1) The major reason for unreliability of stockholders to enter on stock exchange market is lack of adequate information and fear of unreliability of available on stock market. Thus it is recommended that investor and stock market actor hope with increasing investment efficiency and maximum output (return) with minimum risk through modeling from predicting stock price by performed method in present study and minimizing system error during training network at stock exchange market.

2) As, variables DPS and EPS have more influence on stock price, thus it is recommended to investors of

Stock market that to predict stock price, always consider these both important variables:

To research in future, it is suggested that, regard to importance of predicting stock price, it is essential to performing more studies on this area. In order to conducting more research it is suggested that:

- 1) In present research, chemical industry companies have been studied, it is advised to research that study other industry accepted in stock exchange market or as possible, compare two or more industries concerning prediction of stock price.
- 2) In present study data of 5-years duration from 2008 to 2015 have been studied, and then study the higher duration in future is recommended.
- 3) On the other hand, design a new network can be a basis for implement recent research, for example, in present research a network with a hidden layers and sigmoid transition function has been used. Study a network with two or three hidden layers and other transition function such as hyperbolic tangent is recommended.

5. REFERENCES

- [1]. Hatami & Mirzazadeh, Hojat & Ebrahimipoor (2014). Combining neural network to predicting stock price, Economical research-letter, tenth year, N2f
- [2]. Habibi, samaneh (2015). Study the influence of disclose of the profit prediction information on fluctuation of stock price (Medicinal industrial group on Tehran stock exchange market, M.A thesis, Babol Azad University).
- [3]. Khaloozadeh Hamid, Khaki Sedigh, Ali & Lux & Karo (2015). Predicting and modeling stock price in Tehran stock exchange market using linear and nonlinear models. Modarres scientific-research magazine.
- [4]. Tolui Ashlaghi, Abbas and Haghdoost Shadi (2014). Modeling the predict stockprice using neural network and compare it through mathematical prediction method, economical research, p 237-251.
- [5]. Abbasian Ezatollah & Radpoor Oladi, Mehdi and Abbasian Vahid. (2013) influence of economic macro-variables on total index of Tehran stock exchange market.
- [6]. Arab Mostafa (2014). Comoare the method of neural network with ARIMA method in predict stock price (case study of petrochemical industries investment company). M.A thesis, Tehran Tarbiat Modares University.
- [7]. Najarzadeh Reza, Aghai Khondabi Majid and Rezapoor Mohammad (2012). study influence of price and exchange shocks and fluctuations on stock price index of Tehran stock exchange market using self-regression finder, season-letter of economic research. ninth year, first number. page 147-175
- [8]. Heibati Farshad & Mosavi Seyd Mostafa. (2010) predicting stock exchange index using modeling. Economical research-letter, special for capital market, sevsenth number.