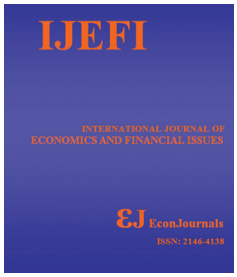


International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(3), 119-127.

The Use of Artificial Neural Networks for Quantifying the Relative Importance of the Firms' Performance Determinants

Gholamhossein Mahdavi[1], Mohammad Sadeghzadeh Maharluie[2]*, Ahmad Shokrolahi[3]

[1]Shiraz University, Iran, [2]Shiraz University, Iran, [3]Shiraz University, Iran. *Email: sadeghzadeh.mohammad@gmail.com

ABSTRACT

Performance is the outcome of all plans and decisions of a company. It shows the ways companies are governed. Consequently, determining the relative importance (RI) of factors influencing the performance is important. Therefore, in this study, seven independent variables were determined based on the literature. Then, the significant variables were chosen using the Pearson's correlation test. Finally, an artificial neural network was designed to investigate the RI of the determinants. In total, 1340 company-year data were collected from Tehran stock exchange from 2001 to 2010. The research results revealed that institutional ownership concentration is the most important factor which is followed by state ownership, and managerial stock ownership. Debt policy and firm size are ranked in lower position.

Keywords: Performance, Artificial Neural Networks, Tehran Stock Exchange
JEL Classification: M49

1. INTRODUCTION

From the 19th century, many of the companies use important accounting variables such as sale, income and income to sale ratio in a classical way to evaluate managers' performance. Although these methods are quite common in practice even these days, they are not appropriate methods to evaluate managers' performance (Namazi, 2003. p. 163).

Most studies (Lun and Quaddus, 2011; Chen et al., 2011; Alfaraih et al., 2012; Faruk and Ayub, 2012) have considered the linearity assumption of the relationship between the firm's performance and its influential factors. In spite of this, so far there have been few attempts to study the problem with the nonlinear approaches. Therefore, the major aim of this study is to investigate and quantify the role of the determinants of firms' performance through artificial neural networks. In other words, by considering the relationship among variables, this study attempts to respond to the question: Among various factors, what is the relative importance (RI) of the determinants of the firms' performance?

Both traditional statistical approaches and modern artificial neural networks (ANN) techniques could be used to respond to the preceding question. According to Bejou et al. (1996), the ANNs have relative advantages regarding more widely used approaches such as regression. First, ANNs have more general functional form than the well-developed statistical methods. Second, the associative ability which means ANN is generally robust to missing or inaccurate data. Third, multicollinearity does not impact on the ANN's performance as it does on the performance of least square regression (Bejou et al., 1996. p. 138).

This paper has two objectives. First is investigating the influencing factors affecting the firms' performance in Tehran stock exchange (TSE) market. Second, the selected variables would be ranked according their importance in determining the firms' performance based on ANN analysis. Thus, we use a new approach in this regard which is to our knowledge, is the first attempt in ranking the RI of firms' performance factors. Previous studies have only attempted to determine the positive or negative effects of the significant variables affecting the firms' performance. However, this study, for the first time, concentrated on the ranking of the significant factors affecting the firms' performance, which were identified by previous researchers, via ANN.

The remainder of this paper is organized as follows. First, we review the theoretical backgrounds. Second, we review the

literature review and hypotheses. Third, the research method, data sample, research design, and research variables will be explained respectively. Fourth, the research model will be discussed accordingly. Fifth, the results will be presented. Finally, the conclusion and discussion will be rendered.

2. THEORETICAL BACKGROUND

2.1. Tobin-Q

In 1996, James Tobin rendered a new index for evaluating the profitability of investments projects called Tobin-Q. Tobin's Q is defined as the market value of total assets deflated by the book value of total assets and is calculated as the ratio of the market value of equity plus the book value of total debts to the book value of total assets (Wu et el., 2011). After Tobin, this ratio has been used by many researchers. The other researchers made some changes in the ratio which had been rendered by Tobin in 1996 and expanded it. Among them are: Simple Tobin-Qs, Standard Tobin-Qs, Lindenberg's and Ross's Qs, Adjusted Lindenberg's and Ross's Qs, Leewillen's and Badernet's Qs, Chung's and Pruitt's Qs, and Jurkus et al.'s Qs.

2.2. Trade-off Theory

The trade-off theory posits that there is an optimal level of capital structure in which the firm value is maximized. At the optimal point, the marginal benefits of debt equal the marginal costs of debt and the firm performance is maximized (Tang and Jang, 2007; Jang et al., 2008). Compared with equity financing, debt is cheaper because it is tax deductible. Nevertheless, an excessive use of debt is risky as a result of the higher likelihood of bankruptcy. Thus, the trade-off theory argues that firms set an optimal target debt ratio determined by the trade-off between the benefits and costs of debt (Park and Jang, 2013).

2.3. Pecking-order Theory

Myers (1984) suggested that the costs of issuing risky debt or equity overwhelm the forces that determine optimal leverage in the trade-off model. This is referred to as the pecking-order theory. Pecking-order refers to the idea that in order to minimize asymmetric information and other financing costs, firms should first finance investments with retained earnings, then with safe debt, followed by risky debt, and finally with equity. Based on this, Myers (1984) defined "safe debt" as newly issued debt that is default-risk free. According to simple pecking order theory, debt typically grows when investments exceed retained earnings and it falls when investments are less than retained earnings.

2.4. Agency Theory

In the agency models of Jensen and Meckling (1976) and Jensen (1986), there are conflicts of interest between managers and stock-holders. The interests of managers are not aligned with those of investors. Managers tend to waste free cash flow on perquisites. As Jensen (1986) argued, the greater the discretionary amount available to a manager, the greater the likelihood that the manager will use it for perquisites.

3. LITERATURE REVIEW AND HYPOTHESES

3.1. Performance

According to the researches of Cornett et al. (2007), Elyasiani and Jia (2008), and Drako and Bekiris (2010), the Tobin-Q's was chosen as a criterion for measuring the performance. Based on this, Steven and Kenneet (1994) discussed the use of Tobin-Q as a criterion for measuring the firm's performance. They also examined other kinds of Tobin-Qs. Their research results revealed that mean, median and standard deviation of common kinds of Tobin-Qs are equal to some extent. Also, Salinger (1984) used Q-index as a criterion to measure the monoply power of the company and investigated the market structure of the profitability. One of the results of his research posits the superiority of the Tobin-Q as a criterion for measuring the monoply power of the company.

3.2. Debt Policy

One of the important decisions companies are face with is choosing the debt policy or capital structure. It is important for a company to find a synthesis of debt and equity which maximize the market value of the company (Abor, 2007. p. 364). Jensen (1986) predicted that increase in leverage, disciplines the management and decrease the opportunistic behaviour. It means that creating debt put managers in the creditors monitoring realm. Consequently, this has a considerable effect on the performance of the company. According to the trade-off theory, profitable companies have higher debt ratio as a result of the less bankruptcy expense and higher income. Other researchers such as Rajan and Zingales (1995), Booth et al. (2001), Supanvanij (2006), Sayilgan et al. (2006), De Jong et al. (2008), Karadeniz et al. (2009) and Sheikh and Wang (2010) showed a significant relationship between profitability and debt policy. Consequently, the following hypothesis is presented:

H_1: There is a significant relationship between the debt policy and the firm's performance.

3.3. Ownership Structure

Ownership structure illustrates the composition of the shareholders. Based on this, institutional ownership including level and concentration of the institutional ownership, managerial stock ownership, and state ownership would be examined in this study.

3.3.1. Institutional ownership

Chung et al. (2005) contend that if institutions own a large percentage of a company's shares, then they have incentives to monitor management's actions and decisions. In addition, based on the agency theory, Velury and Jenkins (2006) argued that this major role roots in the monitoring activities owners perform to monitor the managers. In addition to that, the results of Bhattacharya and Graham's (2009) study revealed that a more equal distribution of the voting power among the largest institutional stakeholder may exert positive effects on firm performance. Henry's (2010) and Alfaraih et al.'s (2012) research results revealed that the institutional ownership can improve the firm's performance.

3.3.2. Concentration and level of institutional ownership

Xu and Wang (1999), using Chinese company data, found a positive correlation between ownership concentration and the firm's performance. On the other hand, Chang and Leng (2004) found that board size and institutional investors on the board have a positive impact on the firms' performance. In addition to the aforementioned scholar works, Kapopoulos and Lazaretou (2007) suggested that a more concentrated ownership structure relates positively to higher firm profitability. They interpreted the results as supporting the notion that the larger the ownership concentration, the more effective management behaviour is monitored.

3.3.3. State ownership

The state ownership in most cases has been exclusive because the goal of achieving gain is less important. It also doesn't include the monitoring power of the shareholders. Furthermore, in state ownership, political status concerns will be considered. On the other hand, private ownerships would reduce the inefficiency due to competition and shareholders' monitoring (Fatma and Chichti, 2011. p. 774). Based on this, Chen et al. (2011) revealed that the sensitivity of capital expenditure to investment opportunity in a state ownership is significantly lower. Also, political relationship in state companies cause reduction in the efficiency of the investments while such a relationship is not seen in non-state companies. In summary, the results showed that government interference in state companies damages investors' behaviour and efficiency of the investments.

3.4. Managerial Stock Ownership

Jensen and Meckling (1976) argued that an increase in managerial stock ownerships would increase the firm values by reducing the agency problems. In addition, Khan et al. (2007) found a negative and significant relationship between managerial stock ownership and Tobin-Q by using a simple linear regression. Drakos and Bekiris (2010) research results revealed that exerting managerial ownership as an endogenous variable has a significant and positive effect on firm's performance. According to aforementioned researches, the following hypotheses are presented:

H_2: There is a significant relationship between the ownership concentration and the firm's performance.

H_3: There is a significant relationship between the ownership level and the firm's performance.

H_4: There is a significant relationship between the managerial stock ownership and the firm's performance.

H_5: There is a significant relationship between the state ownership and the firm's performance.

3.5. Tax

Mitra and Stern (2002) posited that mismanagement of income tax is one of the principal causes of persistent budget deficits, and also mismanagement of tax forces business to close down most of the time. Wilson et al. (2009) and Lisowsky et al. (2013) also argued that despite the significant tax savings generated by tax avoidance activities, there is mixed evidence on the implications of tax avoidance for firm value. Based on this, it must be stated that the influence of tax on performance is complex and difficult to predict because it depends on the principles of tax deductibility of interest, income tax and non-debt tax shield, but it can be inferred that this is an important variable in determining the firm's performance. Based on this, the following hypothesis is stated:

H_6: There is a significant relationship between tax and the firm's performance.

3.6. Firm Size

Scale economies provide a competitive advantage, both directly by reducing per unit costs and indirectly by leading to horizontal expansion in firm boundaries, and this leads to the benefits of improvement in profitability (Lun and Quaddus, 2011). The financial literature tends to support that larger firms perform better. Performance can be conceptualized as the extent to which the firm's goals, such as sales growth, profitability, and customer satisfaction level are achieved (Ellinger et al., 2000). A number of studies (Ramaswamy, 2001; Frank and Goyal, 2003) have suggested that firm size might influence firm performance. For example, Fama and French (1995) have shown that smaller firms, on average, have lower return on equity than larger firms. Therefore, the following hypothesis is stated:

H_7: There is a significant relationship between the firm size and the firm's performance.

4. METHODOLOGY AND RESEARCH DESIGN

4.1. Research Design and Data Collection

This research is in the positive research domain on the basis of historical data, and uses a one-way quasi-experimental research plan. The data is mainly derived from the audited financial statements of the TSE, and Tadbir Pardaz software.

This research data relates to all TSE listed companies from 2001 to 2010. However, in this research, purposive sampling was exerted, thus financial firms such as banks and insurance companies were omitted because they maintain different conditions in relation to leverages and cash flows. Selected companies must also have continuous operations from 2001 to 2010. And their financial and nonfinancial information must be available. After exerting these criteria, the sample study was reduced to 134 companies in 10 years, making it a total of 1340 companies.

4.2. Research Variables

4.2.1. Performance

In this research, the newest formula which was proposed by Jurkus et al. (2010. p. 182) was used.

$$\text{Tobin's Q} = \frac{\text{MVOCE} + \text{PSLV} + \text{BVOLTD} - (\text{BVOSHTA} - \text{BVOSHTL})}{\text{BVOTA}} \quad (1)$$

Where:

MVOCE = Market value of all common stocks at the end of the fiscal year.

PSLV = Cash values of the preferred stocks at the end of the fiscal year.
BVOLTD = Book values of the long debts at the end of the fiscal year.
BVOSHTA = Book values of the current assets at the end of the fiscal year.
BVOSHTL= Book values of the current debts at the end of the fiscal year.
BVOTA = Book values of the total assets at the end of the fiscal year.

4.2.2. Debt policy

Debt policy has been defined by various measures, depending on the goal of the analysis. Many researchers such as Du and Dai (2005. p. 64) have applied the total debt divided by the total assets. However, Fatma and Chichti (2011. p. 17) stated that the ratio of total debt divided by total assets is not a suitable parameter for measuring risk. Therefore, in this study, the long term debt was used because it plays a more effective role in the investments. Pao (2008) argued that separation of the long term and current liabilities in developing markets is more suitable. This measure has also been used by Pöyry and Maury (2010) and Mello and Miranda (2010), among others. Therefore, in this study, the debt policy measure was defined as follows:

$$\text{Debt policy} = \frac{\text{Long term liabilities}}{\text{Total assets}} \quad (2)$$

4.2.3. Institutional ownership

In this study, institutional ownership was examined from the point of view of level and concentration.

4.2.3.1. Level of institutional ownership

Rubin (2007) and Cueto (2009) defined the level of the institutional ownerships as the stocks belongings to the banks, insurance companies, corporate holdings, investment firms, retirement funds, investment funds, government's companies and organisations divided by the all issued shares. This variable was also applied by Kumar (2003), Earnhart and Lizal (2006).

$$\text{Institutional ownership level} = \frac{\text{Sum of the stocks in hand of the institutional ownership}}{\text{All issued shares}} \quad (3)$$

4.2.3.2. Concentration of institutional ownership

Concentration of institutional ownership is the sum of the stocks on hand of the greatest institutional owners divided by the all issued shares. This variable was also applied in the research of Rubin (2007). Consequently, in this study, the following ratio is used:

$$\text{Institutional ownership concentration} = \frac{\text{Sum of the stocks in hand of thegreatest institutional ownership}}{\text{All issued shares}} \quad (4)$$

4.2.4. State ownership

This variable according to Wu et al. (2011) and Fatma and Chichti (2011) is defined as:

$$\text{State ownership} = \frac{\text{Amount of shares that were owned directly or indirectly by the state}}{\text{Total of shares}} \quad (5)$$

4.2.5. Managerial stock ownership

In this study, according to Cornett et al. (2007) and Hasan and Butt (2009), managerial ownership is defined as the percentage of the common stocks which belongs to the managers of a company.

4.2.6. Tax

According to Céspedes et al. (2010), and Fatma and Chichti (2011), tax variable is defined as follows:

$$\text{Tax} = \frac{\text{Income before tax and interest}}{\text{Total assets}} \quad (6)$$

4.2.7. Firm size

Although, researchers have exerted many factors for calculating the effects of the firm size variable such as the logarithm of all assets or logarithm of the sales, the inflation situation of Iran; has however caused the irrelevancy of these factors (Namazi and Monfared, 2012. p. 14). Therefore, in this study, the natural logarithm of the market size of the company at the end of the fiscal year is used. This variable was also used by Boone et al. (2007), Namazi and Monfared (2012), and Namazi et al. (2016). Hence, in this study, size is defined as:

Size=Natural logarithm of the market value of the company (7)

5. RESEARCH MODEL

Figure 1 which was adapted from Hudson et al. (2012) shows the structure of the model. To design this model, MATLAB software, 2011 edition was used.

There are three indexes for measuring the ANN performance: Mean squared error (MSE), sum of squared error (SSE) and mean absolute error. Fortunately, several works have been carried out in an attempt to determine the relative contribution of each input to each output unit in an ANN (Hu and Tsoukalas, 2003; Olden and Jackson, 2002; Perzyk et al., 2005; Wong et al., 2011, Xu et al., 2013, Namazi et al., 2016). For example, the work carried out by Sung (1998) revealed two methods of ranking or quantifying the importance among inputs to a single output: (i) The sensitivity analysis and (ii) the change of the MSE. He concluded that the two methods yield similar outcomes. However, because in our research model, the mode error is quite close to zero, therefore, MSE is not a suitable method in our research and we apply the SSE. Consequently, we would apply the SSE technique to determine the RI of the performance among different factors. SSE is calculated according to the following formula:

$$SSE = \frac{1}{N}\sum_{p=1}^{N}\sum_{i=1}^{M}\left(o_{pi} - t_{pi}\right)^2$$

Where "o_{pi}" and "t_{pi}" are respectively actual and target solution of the "i^{th}" output nodes on the "p^{th}" example, "N" is the number of training examples and "M" is the number of output nodes (Sohrabi et al., 2013).

6. RESULTS

Table 1 shows the descriptive statistics of the study.

The means of the institutional ownership level and institutional ownership concentration show that almost half of the ownership in the examined sample belongs to institutional owners. Also, the mean of the state ownership is 38.98. It shows the significant role of the institutional ownership in the process of decision making.

The economic situations of Iran as an emerging market might be different from that of other countries; therefore, some variables that were shown by previous research to be important do not work in TSE market. Therefore, the correlation test was exerted to determine the significant factors in TSE environment. Table 2 shows the results. The results supported the H1, H2, H4, H5, and H7. Also the results reject the H3 and H6. According to obtained results, due to having significant relation debt policy, institutional ownership concentration, managerial ownership, state ownership, and firm's size variables were chosen as input variables in ANN model.

The problem an ANN may face is over training. To solve this problem, the data was divided into three groups: train data, validation data and test data with 60, 20 and 20% respectively.

An ANN was separately designed for each of the instances. The SSE for each preceding instances is shown in Table 3.

After determining the SSE for the three-layer ANN, the SSE fluctuations were plotted while the numbers of neurons in the hidden layer were changed. Figure 2 shows that the least SSE in the neural networks contains 18 and 19 neurons. Increasing the number of neurons in the hidden layers encountered some problems such as increasing the amount of time that is needed to run the model, in addition to its complexity.

Figure 3 shows the performance of the neural networks with the train data. It is clear from this figure that one cannot conclude the performance because the neural networks expend them to fit a

Figure 1: The structure of the model. Hudson et al. (2012. p. 152)

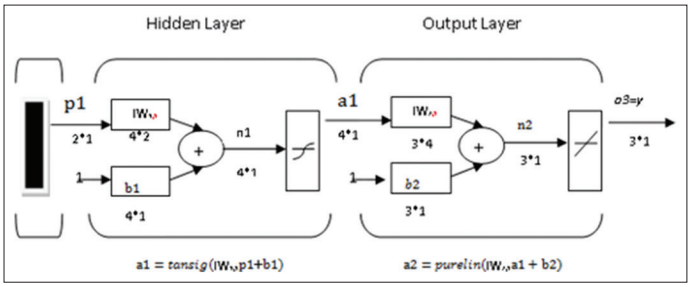


Figure 3: Sum of squared error of the train data versus the number of neurons

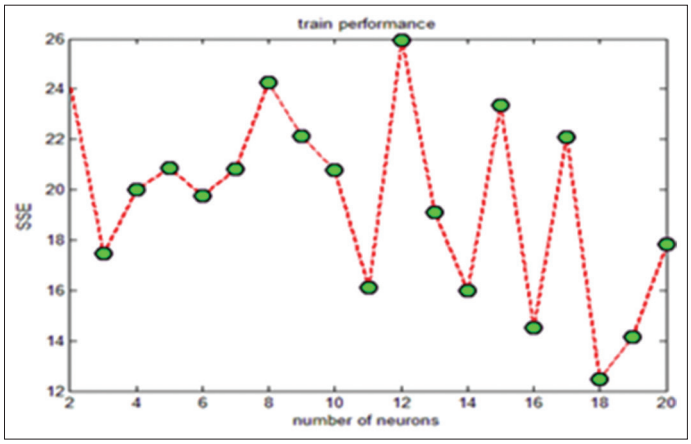


Table 1: Descriptive statistics

Variables	Mean	Median	Standard deviation	Minimum	Maximum
Tobin-Q	0.992516	0.654316	1.182314	−0.35286	12.67112
Debt policy	0.076034	0.051472	0.087595	0	0.937411
Size	12.23891	12.05502	1.526667	8.431799	17.14851
Tax	0.672895	0.103604	7.585995	−16.5554	165.375
Institutional ownership level	54.33739	54.939	26.68583	0	99.99
Institutional ownership concentration	46.74906	49	24.342	0	99.99
Managerial stock ownership	6.321413	0	17.47932	0	97.93
State ownership	38.98912	45.32	32.30911	0	99.99

Table 2: Results of testing the hypotheses

Variables	Correlation	Sig	Results
Debt policy	0.100**	0.000	H_1 supported
Institutional ownership concentration	−0.058*	0.035	H_2 supported
Institutional ownership level	0.002	0.934	H^3 not supported
Managerial stock ownership	−0.154**	0.000	H_4 supported
State ownership	0.113**	0.000	H_5 supported
Tax	−0.026	0.339	H_6 not supported
Size	0.378**	0.000	H_7 supported

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed)

Table 3: SSE for three-layer ANN

Node	Train performance	Validation performance	Test performance	Performance
2	24.0657	4.5692	7.358	35.9929
3	17.4792	7.4463	10.1749	35.1004
4	19.9994	4.792	8.2622	33.0536
5	20.8638	8.1225	6.2039	35.1902
6	19.7759	6.924	7.5279	34.2278
7	20.8254	7.9171	6.7947	35.5372
8	24.2543	4.1111	7.3966	35.7621
9	22.1221	6.9309	6.2074	35.2604
10	20.768	7.2093	4.1202	32.0975
11	16.1197	8.3193	7.3162	31.7552
12	25.9558	7.2832	10.0545	43.2934
13	19.0847	8.4596	7.3894	34.9337
14	16.0116	6.5216	11.9487	34.4819
15	23.3746	5.1672	5.6741	34.2159
16	14.5367	9.6338	8.8763	33.0467
17	22.0809	4.858	6.0678	33.0067
18	12.4761	11.355	10.3435	34.1745
19	14.1631	10.6095	8.8941	33.6667
20	17.8275	6.5534	9.3023	33.6832

SSE: Sum of squared error, ANN: Artificial neural networks

model. However, it can be observed that the increase in the number of neurons would not result in achieving better performance in a row and it has some anomalies.

Figure 2 shows the data validation performance. It can be seen that the models with 2 and 8 neurons posit the best SSE among all samples.

Figure 4 shows the SSE for the test data. It can be seen that the models with 10 and 15 neurons have the best SSE among all models.

In summary, the optimal model with a three-layer ANN has the following characteristics: One input layer with 5 neurons and one hidden layer with 10 neurons and tangent sigmoid as a transfer function and one output layer with 1 neuron and Purelin as a transfer function. The SSE of the test data for this model is 4.1202.

Error histogram for the chosen model is shown in Figure 5. It shows that the zero error line is between the data. It shows that the mode of error is quite close to zero which indicates the good performance of the ANN in predicting the performance.

Figure 6 shows the SSE changes among the three groups of data: train data, validation data, and test data in the chosen model.

After the ANN model is deemed reliable, some previous studies would have made use of the model parameters (i.e., the connection weights between input units, hidden units, and output units) for determining the RI of each input to the single output (Deng et al., 2008; Deng and Pei, 2009; Huang et al., 2004). However, as earlier mentioned we exert the change of SSE.

In brief, for the change of the SSE method, one should measure the change (increase or decrease) in predicting the SSE of an ANN after an input unit is deleted from the input layer of that ANN.

Figure 2: Sum of squared error of the validation data versus the number of neurons

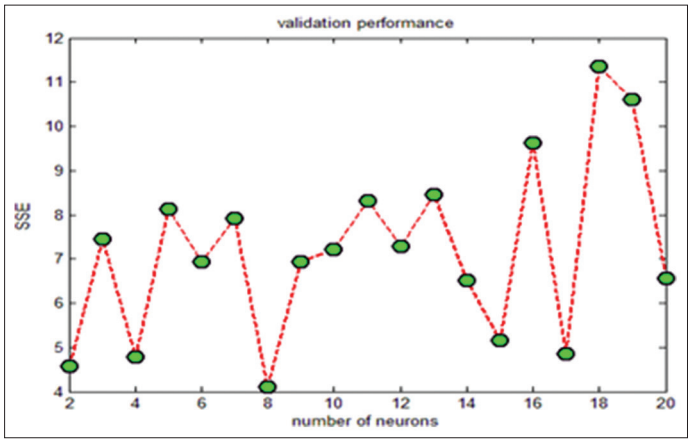


Figure 4: Sum of squared error of the test data versus the number of neurons

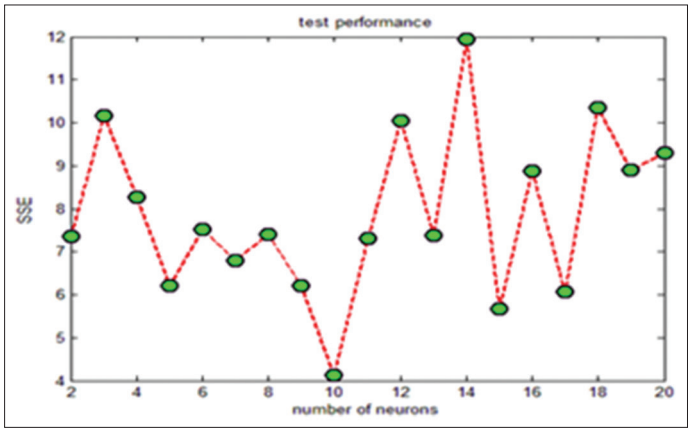
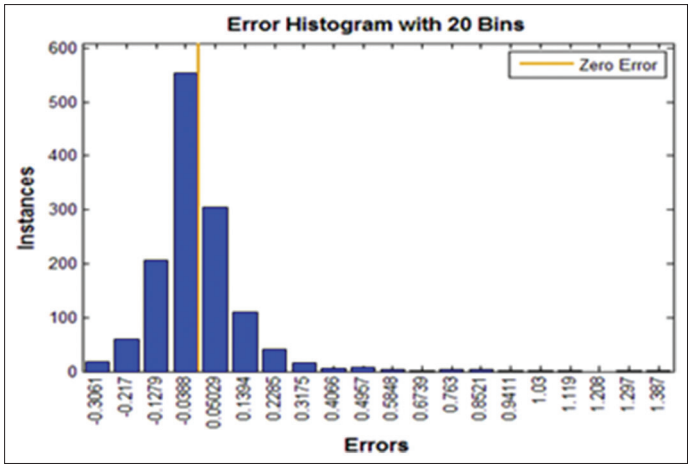


Figure 5: Error histogram with 20 bins



Thus, we retrained each ANN model with (N-1) inputs each time after an input unit is deleted and then we computed the change in SSE for the reduced ANN model relative to the full ANN model with N input units.

Then we ranked the input variable whose deletion triggers the largest changes in the SSE as the most important input variable, since its exclusion from the full ANN, was what mostly deteriorates

the prediction accuracy. The RI of each factor can then be quantified based on the proportion of the changes which is induced by each factor relative to total changes in the SSE induced by all the factors. The results are shown in Table 4 and Figure 7.

Table 4 also reports that institutional ownership concentration is the most important factor affecting the performance with RI = 0.2985. The table also shows that the RI of the state ownership is 0.2754, which placed this variable in the second rank. In addition, the RI of the managerial stock ownership, debt policy, and size in determining the performance is 0.1722, 0.1674, and 0.0863 respectively.

Table 4: The change of SSE computation for the three-layer ANN

States	SSE	Change	Relative Importance	Rank
Full model with 10 neurons	32.0975			
Omit institutional ownership concentration	406.424	374.32	0.2985	1
Omit state ownership	377.478	345.38	0.2754	2
Omit managerial stock ownership	248.094	215.99	0.1722	3
Omit debt policy	242.026	209.92	0.1674	4
Omit size	140.435	108.33	0.0863	5

SSE: Sum of squared error, ANN: Artificial neural networks

Figure 6: Sum of squared error of the best validation performance

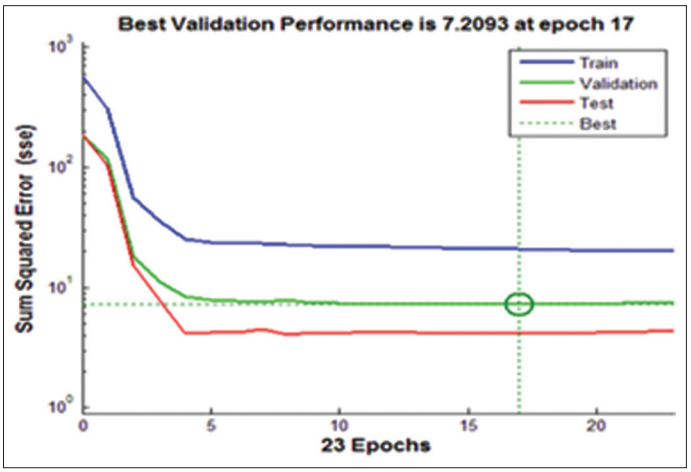
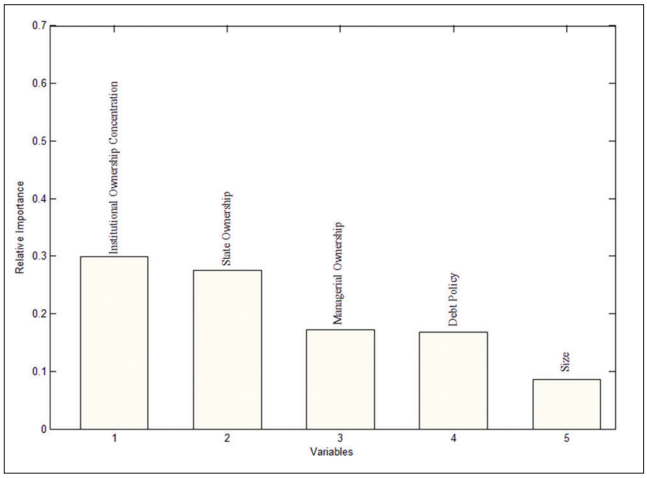


Figure 7: Relative importance versus omitting variables



7. DISCUSSION AND CONCLUSION

The result of the ANN approach showed that the institutional ownership concentration is the most important variable among the investigated variables in determining the performance. It is followed by state ownership with near RI (difference in RI is 0.0231). It shows the better performance of the state companies. One possible explanation may be the suitability of Iran's environment for state companies in respect to other companies. Because the government try to prepare better environment for its companies by preparing the suitable means for them and in some cases by supporting them and giving them privileges that can work as a competitive advantage. The managerial ownership is ranked in third place. It must be mentioned that ranking in lower position of this variable can be the consequence of the power of institutional ownership concentration and state ownership which dominate the managers and reduce the power of the managers. The above mentioned result shows the superiority of the structural ownership in determining the performance. In other words, increase in the power of a company (the greatest shareholders), state ownership and an individual (manager) can result in them pursuing their goals instead of the companies' goals and therefore influence the performance of the firms. Agency theory posits that debt policy can be a significant variable in determining the performance. Also, trade-off theory argues that by determining the optimal level of debt, the market value of the company could be maximized. But in this research, among the investigated variables, debt policy is the fourth variable. Regarding profitability, it could be argued that companies might perform earnings management. Therefore, the results of this study indicate that monitoring powers of the creditors is less important relative to other variables in determining the performance. Finally, the result of the ANN approach showed that the firm size is the least important variable among the investigated variables in determining the performance. It is opposite to the theory of low cost which is derived from scale as a primary source of the competitive advantage. Due to economies of scale, big firms by reducing the per unit cost and also, by horizontal expansion in firm's boundaries pursue improvement in firm's performance.

In summary, we believe that proposed ranking can also help capital market to consider the RI of the investigated variables.

The findings of this research differ from that of earlier studies (Rajan and Zingales, 1995; Gillan and Starks, 1998; Xu and Wang, 1999; Booth et al., 2001; Chang and Leng, 2004; Sayilgan et al., 2006; Supanvanij, 2006; Huang and Song, 2006; Rahman Khan et al., 2007; De Jong et al., 2008; Karadeniz et al., 2009; Céspedes et al., 2010; Sheikh and Wang, 2010; Henry, 2010; Drakos and Bekiris, 2010; Fatma and Chichti, 2011; Lun and Quaddus, 2011; Chen et al., 2011; Alfaraih et al., 2012; Faruk and Ayub, 2012) because, previous studies have only attempted to determine the positive or negative effects of the significant variables which affect the performance. This study, however, for the first time, concentrated on the ranking of the significant factors affecting the

performance, which were identified by previous researchers via ANN. Thus, this study extends previous works and the existing financial literature on the performance subject. For interested researchers, it is suggested that they should consider working on ranking the board's structure variable in determining the firm's performance. Investigate important variables in determining firm's performance according to the idea of financial statement users. Conduct the current research in other organized stock exchange. Finally, investigate the RI of factors which determine other important indexes.

Like any research, we had some limitations such as non-availability of some characteristics of the boards' members and institutional investors. The variables that were not disclosed by the firms and the economic situation of Iran can cause an issue in generalizing the results. The limitation of ANN must also be considered. However, we believe that none of these limitations significantly affected the internal and external validity of this study.

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