



## Identifying and Explaining the Factors Affecting the Fiscal Discipline of Companies Accepted in Tehran Stock Exchange Using Artificial Neural Network

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### ABSTRACT

Fiscal discipline provides a mechanism for maintaining financial health and a favorable vision for listed companies by matching revenue and expenses with goal achievement programs (GAP), which, if realized, can ensure the success of these companies. Thus, this study was carried out aimed to identify and explain the factors affecting the fiscal discipline of companies listed on the Tehran Stock Exchange. The present study is considered as an applied research in terms of purpose and as a descriptive survey research in terms of method. In this study, population is listed companies that 114 companies have been selected as a sample using systematic sampling method. Analysis of research data was done using Artificial Neural Network (ANN) and two-layer perceptron and Matlab software. The results show that the most important factors affecting fiscal discipline include financial health, financial stability, debt growth rate, capital expenditures, profitability, and firm value and information uncertainty of companies.

### Keywords:

Fiscal Discipline, Companies Accepted in Tehran Stock Exchange (TSE), Artificial Neural Network.

## 1. Introduction

Nowadays, the existence of negative phenomena such as the beneficial actions of politicians, businessmen, public and private organizations, or more generally, financial corruption, in an improper and illegal way by wasting resources, is considered as a serious threat to economic stability, growth and development. In fact, financial corruption leads to undermine moral values in society, reduce efficiency and effectiveness in organizations, and ultimately the inadequacy of government in directing affairs (Yohou, 2020). On the other hand, managers of various organizations and institutions have faced concerns to prevent disruption of the market and the economic system due to correct information-based proper planning, a more accurate picture of the amount and composition of expenditures and revenues, monitoring the types of payments and preventing resources deficits in the implementation process. Therefore, paying attention to fiscal discipline is considered as one of the important infrastructures to get rid of these challenges in the financial literature (Onofrei et al., 2020). Fiscal discipline is defined as an essential approach to improve and sustain economic performance, reducing financial corruption, maintaining economic stability, and reducing a company's competitiveness in the field of competition (Canofari et al., 2020). In other words, fiscal discipline refers to match revenue and expenditure with goal achievement programs, a mechanism for maintaining financial health, and a multi-year vision for budgeting (Eklou & Joanis, 2019). The mission of any organization and company is to strive to achieve predetermined goals, and fiscal discipline is considered as a determining element that determines the efficiency of an enterprise in achieving those goals (Neto, 2020).

Of course, it is very important to establish and implement fiscal discipline for any organization and company. Applying this approach informs the organization about its efficiency and effectiveness. In fact, it makes clear that the organization uses its capital, manpower and other facilities in an optimal way to improve performance and ultimately achieve its ideals. Obviously, fiscal discipline prevents the waste of resources, enabling the organization to evaluate performance, to use internal and external resources, as well as to analyze the profitability (Tofan et al., 2020). Undoubtedly, large investments are necessary for

economic growth and development, and securing these investments is impossible through markets whose returns are guaranteed in the short term. Thus, creating a strong and efficient capital market is of importance in financing basic projects for government and organizations. In recent years, the position of the stock exchange has become more prominent and important due to the potential and ease of financing through the issuance of stocks and other securities, increasing domestic and foreign credit and financing. In fact, a suitable context for business and economic prosperity is provided by this market by collecting micro and macro savings. On the other hand, one of the effective levers in economic growth and development is the activity of listed companies. Because the success of companies in this field will lead to increase production and sales rate, profitability, job creation, self-sufficiency, as well as the ability to compete nationally and internationally. Thus, creating a fiscal discipline mechanism in listed companies not only determines their efficiency and effectiveness; it also provides a good context business active in the stock market. It should be noted that unfortunately, the research gap in this field is obvious due to the importance of the subject and review of the research literature and the subject has not been sufficiently addressed in domestic research. Also, according to the literature review, the fiscal discipline approach can be examined both at the macro and micro levels. Therefore, the purpose of this study is to identify and explain the factors affecting fiscal discipline in listed companies using artificial neural networks.

## Theoretical Foundations

### Fiscal discipline

In 2008, the focus on financial sustainability increased with the outbreak of the global financial crisis and disciplinary policies, especially fiscal discipline, earned a special place in the economic literature (De jong and Gilbert, 2019). The global economic crisis of 2008 created serious challenges to the economies of the world, especially European and American countries, so that its harmful effects are reflected in the macroeconomic indicators of these countries (Petkov, 2014). In today's world of economics, financial stability and the need for fiscal discipline are inevitable, both at the micro and macro levels (Giles et al., 2016). In fact, fiscal discipline as

one of the most important propellants of developed countries leads to stabilize and prosper their economy and consequently their financial markets (Wyplosz, 2012). Keita and Turku (2019) have examined in a study how financial laws and exchange rate decisions affect fiscal discipline. Keita and Turcu (2019) during a study examined how financial laws and exchange rate-related decisions have an effect on fiscal discipline. According to their results, financial laws and making the right decisions on the exchange rate alone are not enough to improve fiscal discipline. Also, Jaswadi et al (2012) carried out a study aimed to examine the corporate governance mechanisms as an effective tool to protect financial users against fiscal indiscipline. According to the results, the audit committee can be considered as an effective tool in reducing fiscal indiscipline and increasing the accounting order in companies. Sucharita and Sethi (2011) during a study concluded that financial responsibility and budget management law plays a key role in restoring fiscal balance and discipline to companies.

Fiscal discipline is considered as one of the most important issues in making decisions and adopting monetary and fiscal policies (Evans and Olaniyi, 2020). In the global economy, the need for fiscal discipline became more apparent by overshadowing the recession and crisis and its effects on the structure of the world economy (Riga, 2019). By reviewing the history of the world economy and studying the financial crises of some major global economies and their gradual spread to other international financial markets, it can be concluded that many countries have sought to control the negative effects of the crisis by using appropriate policy tools such as fiscal discipline policies (Chowdhury et al., 2016). Thus, it is of particular importance that each country chooses what kind of economic policy by considering the fiscal discipline to moderate the effects and consequences of the crisis and recession according to its structure and economic situation (Neto, 2020). Javadian et al. (2018) during a study entitled "The effect of performance auditing on the fiscal discipline of NAJA managers" concluded that performance audit has a positive and significant effect on the fiscal discipline of NAJA managers. Also, Esfandiari Safa and Dehghan (2015) investigated the requirements of fiscal discipline from the supreme leader's perspective. According to the results, saving, non-extremity and reforms in the

judiciary system are the most important components of fiscal discipline. Evans and Olaniyi, (2020) conducted a study entitled "Fiscal Discipline, Economic Growth, and Economic Development in Nigeria", which was related to research conducted abroad. The effects of fiscal discipline in the form of policy uncertainty and corruption on financial development and economic growth were investigated using the ARDL method. According to the results, there is a significant relationship between fiscal discipline and financial development and economic growth in both the short and long term. Petkov (2014) during a study investigated the advantages and disadvantages of fiscal discipline in Bulgaria and found that financial deviation has imposed a lot of pressure on economic growth and has a high social cost. Chowdhury et al. (2016) during a study concluded that fraud has significant effects on the success of fiscal discipline for the company. Pattillo (2016) during a study concluded that financial leverage has a significant effect on fiscal discipline. He found that organizational decision-makers plan their activities by anticipating future changes, especially political changes, and accordingly, those who have a long-term horizon; they are more inclined to implement fiscal discipline in their organization.

In the literature of financial management and accounting, the concept of fiscal discipline can be investigated at both micro and macro levels (Ardagna et al., 2006). At the macro level, fiscal discipline refers to the ideal balance between government revenues and expenditures. In an economy, the government runs a budget deficit in the absence of fiscal discipline and its expenditures exceed its revenues, which leads to the devaluation of the national currency and inflation (Piacenza and Turati, 2010). But fiscal discipline means matching expenditures and revenues of a company based on forecasting the revenues of that company at the micro level and at the company level (Evans and Olaniyi, 2020). Fiscal discipline refers to having a plan in the process of obtaining, spending and reporting financial resources (Canofari et al., 2018). Also, fiscal discipline at the company level is defined as the absence of unjustified mistakes in the principles and methods used (Manqele, 2018). In fact, fiscal discipline means that a company is able to strike the ideal balance between its revenues and expenditures based on its revenues and to use the correct methods and principles for predicting and calculating its future

revenues (Evans and Olaniyi, 2020, Manqele, 2018). Thus, the most important goals of fiscal discipline can be defined in the elimination of programs that have no economic justification for the company and control of the total volume of the company within the framework of achievable revenues (Neto, 2020). Ghadirian Arani (2017) in another study examined the relationship between earnings management and year-end adjustments as an indicator of fiscal discipline and concluded that this variable is considered as an important factor in fiscal discipline. On the other hand, according to Dumitru and Stanca (2010), the policies implemented; according to DeLong & Summers (2012) Organizational Strategies (selecting capable managers, conservatism, increasing trust, establishing an internal control system, and reducing financing costs), according to Cakir & Neyapti (2007) financial

concentration, according to Kai (2018), debt growth rate, income decline, regulations, and inflation rate; according to Calmfors (2003) financial deviation; also according to Debrun & Kumar (2007) Organizational Life Cycle are affective on fiscal discipline. On the other hand, Latridi & Kadorinis (2009) during a study concluded that profit management incentives, such as low profitability and high leverage, or in other words, profit manipulation to avoid reducing profits or not showing losses; disrupt the implementation of the fiscal discipline approach. Also, Riel & Tano (2014) believe that auditors' motivation has a significant effect on fiscal discipline; because they may be inclined to submit rejected or conditional reports, as a result, they act more conservatively. Thus, according to the theoretical foundations and studies, table 1, shows the factors affecting fiscal discipline.

**Table1. Factors affecting Fiscal Discipline**

Factors	References	Factors	References
Firm capital expenditures	(Monty And Papanji, 2001)	Financial stability and stability of the company	)Neto, 2020(
Firm profitability	( Tofan et al, 2020)	Firm credit risk	(De Jong and Gilbert, 2020)
Firm life	Myers et al. (2003)(	Firm reputation	(Parts, 2012)
Corporate conservatism	( Kim et al, 2018)	Economic growth and development	(Evans and Olaniyi, 2020)
Firm information uncertainty	(Barniv and Cao, 2009)	Politics and policies imposed	(Rezaei and Mahmoudi, 2013)
Firm 's growth	(Albering et al, 2013)	Financial Leverage	(Patillo,2016)
Firm size	( Wyplosz, 2012)	value of the company	)Dimitra and Stanka ,2012(
exchange rate	(Jalles et al ,.2016)	Company strategies and strategies	(DeLong & Summers2012)
Budgeting rules	(Riga, 2019)	Financial focus	( Cakir & Neyapti ,2007)
Financial deviation	(Petkov, 2014)	Budget Management Act	(Sucharita and seti, 2012)
Development and financial growth of the economy	(Evans and Olaniyi,2020)	Debt growth rate	(Kea, 2018),
Fraud	(Chowdhury,2016)	Financial deviation	( Calmfors, 2003)
Firm Company	(Ardagna,2006))	Earnings management	( Ghadirian Arani, 2017)
Firm financial health	( Piacenza and Turati, 2020)	Financial policies and regulations	(Pourzamani and Ahmadnia, 2015)
Firm size	( Keita and Turku, 2019)	Financial rules	( Rafiee and Safarzadeh , 2014)
Firm life cycle	( Debrun & Kumar, 2007)	Performance audit	( Javadian et al., 2018)
Financial Leverage	( Latridi & Kadorinis ,2009)	Save and prevent excess	( Esfandiari Safa, 2015)
Auditor specialization	(Riel & Tano, 2014)	Audit committees	( Jaswadi et al, 2012)
Audit firm size	(Rafiee and Safarzadeh, 2013)	Financial Leverage	( Nikbakht and Rafiee ,2012)
Company revenue	(Kea.,2018)	Firm life	( Rezaei and Mahmoudi,2013)

It should be noted that, according to internal studies, this did not investigate the indicators and factors affecting fiscal discipline that have been previously addressed in domestic research, and has examined and analyzed those that have not been addressed, which will be addressed in the following sections.

**Information uncertainty (IU):** According to the research conducted by Barniv and Cao (2009), this variable is calculated as follows.

Information uncertainty (IU): Operating cash flow standard deviations / Companies assets

**Conservatism:** Kim et al. (2018), during a study used the following formula to measure conservatism as one of the effective factors in fiscal discipline.

$$EPS_{it}/P_{it-1} = \beta_0 + \beta_1 DR_{it} + \beta_2 RET_{it} + \beta_3 DR_{it} * RET_{it} + \epsilon_{it}$$

Where,

$EPS_{it}$  = Earnings per share in year t

$P_{it-1}$  = Price per share at the beginning of the year t

$DR_{it}$  = Dummy variable, if news is bad (stock returns change from the previous year is negative) is one and otherwise zero.

$RET_{it}$  = Company's stock rate of return

**Firm growth:** In the present study, citing the study conducted by Albring et al. (2013), company growth is calculated using the following formula.

Company growth: changes in company assets/company assets

**Exchange rate fluctuations:** According to the study conducted by Jalles et al. (2016), the exchange rate growth has a significant effect on fiscal discipline, so this variable will be measured as follows.

Exchange rate fluctuations= (Exchange rate at the beginning of the year - Exchange rate at the end of the year) / Exchange rate at the beginning of the year

**Firm life:** According to the results reported by Rezaei and Mahmoudi (2013), who investigated the relationship between company life and yearend adjustments as an indicator for measuring fiscal discipline, this variable is considered to determine the optimal model. In this study, the duration of the company's activity can be defined as the time interval

between the company's admissions to the Tehran Stock Exchange until the years 2014 to 2018.

**Financial health:** This ratio is obtained by dividing the total net firm's net profit after taxes plus the depreciation expense over the total liabilities of the company.

Financial health= Firm's net profit after taxes plus the depreciation expense/ liabilities of the company

**Firm size:** Keita and Turku (2019) and Wyplosz (2012) during their concluded that the size of the company is equal to the natural logarithm of the company's assets.

**Firm reputation:** In order to measure the company reputation in this study, the announcement list of the top 100 companies of the Industrial Management Organization, which is announced annually, has been used. Thus, after selecting and ranking the companies based on the sales volume index, this organization used the size and growth of the company, profitability, exports, liquidity, debt and market index to compare and rank. Thus, in order to measure reputation, the number 1 is assigned to the listed companies under the study, and in contrast, the number zero is given to the companies listed on the stock exchange that has operated in the same industry and did not have the necessary reputation.

**Financial stability:** Financial stability is calculated according to the sum of return on assets and the capital-to-asset ratio of the firm divided by the standard deviation of return on assets.

Financial stability= (Return on assets and capital-to-asset ratio)/ firm's assets

**Debt growth rate:** According to Kea (2018), the debt growth rate is calculated based on the total debts on the total assets, which in this study has been used to measure its effect on fiscal discipline.

Debt growth rate= Total debts/ Total assets

**Auditing expertise:** The market share was used for auditing expertise in the present study. The expertise and experience of the auditor become greater than other competitors by increasing the market share of the auditor. Having a dominant market share indicates that

the auditor has successfully distinguished itself from other competitors in terms of audit quality.

$$MS_{ik} = \frac{\sum_{j=1}^{J_{ik}} TA_{ijk}}{\sum_{i=1}^{I_k} \sum_{j=1}^{J_{ik}} TA_{ijk}}$$

Where,  $MS_{ik}$  is auditing firm's market share in  $k$  industry;  $TA$  is total assets of owners;  $i$  is the symbol of the auditing firm;  $j$  is the client company;  $k$  is the desired industry;  $J_{ik}$  is the number of auditors in the  $k$  industry and  $i$  is the number of auditors in the  $k$  industry.

**Capital Expenditures:** In this study, capital expenditures are calculated according to the following formula:

Changes in the tangible fixed assets in the total assets of the company  $i$  in period  $t$

Capital Expenditures =  $\Delta$  Tangible fixed assets / Total assets

**Profitability:** According to the research of Tofan et al. (2020), the company's profitability variable is calculated and measured as follows.

Profitability = Net profit after taxes / Firm's assets

**Credit risk:** De Jong and Gilbert (2020) during a study concluded that the credit risk index is obtained from the net profit divided by the product of capital in the average interest rate paid by banks. According to this indicator, the economic entity should earn more profit than the bank interest rate. In this study, those companies in which the value of credit risk index is more than 1 are considered as low-risk and companies whose credit risk index is less than 1 are considered as high-risk companies. Given that, in this study, companies are divided into two categories of high-risk and low-risk in the field of receivables, so that, a value of 0 is assigned to companies with the value of credit risk index  $s$  more than 1 (low-risk companies) and a value of 1 is assigned to companies with a credit risk index of less than 1 (high-risk companies).

**Firm Value:** According to Dimitra and Stanka (2010), the value of a company or organization is calculated using the following formula:

Value of the company = Equity market value / Book value of equity

## Research methodology

This study is considered as applied research in terms of purpose and descriptive survey research in terms of method. In the present study, in order to collect information, the data of audit reports of financial statements, statistics and information provided to the stock exchange have been used. In this study, the statistical population includes all companies listed on the Tehran Stock Exchange. The following conditions have been selected, which have been selected using the sampling method by systematic elimination method during 2014-2018 and from all companies listed on the Tehran Stock Exchange, companies that have the following conditions:

- 1) Companies whose shares are active in the research period (2014-2018) and the desired data is available.
- 2) There is no change in the fiscal year in the review period of these companies.
- 3) Their financial period should end in March in terms of increasing comparability. The reason for this limitation is that in calculating the variables, the time periods are as similar as possible and the seasonal conditions and factors do not have any significant effects on the selection of factors and variables. Intermediary, holding, banking and investment groups are not suitable for this research due to the completely different nature of their activities and the specific combination of their costs and revenues and are excluded from the sample of this study. There should be no trading interruption of more than six months in the research period.

In the present study, a multilayer perceptron neural network was made after preparing the data through Excel software and performing the necessary calculations to achieve the required ratios using Matlab software. Input variables in Artificial Neural Networks have been used to measure the effectiveness of the research variables and to determine the significance of the relationship between the variables.

Table (1) Sampling method and companies listed on the Tehran Stock Exchange until the end of 2018

Remaining companies after imposing restrictions	Companies removed	Sampling conditions
293	238	Companies whose shares were not active during the research period and the required data are not available
276	17	Companies that have had a change in the fiscal year during the review period
173	103	Companies whose fiscal year does not end with the end of March
146	27	Companies that are part of intermediation, holding, banking and investment groups
114	32	Companies that have had trading interruptions
114	-	Selected companies

### Multilayer perceptron neural network

Perceptron neural networks, especially multilayer perceptrons, are considered as one of the most commonly used artificial neural networks (ANNs). These networks can perform a nonlinear mapping with desired accuracy by selecting the number of layers and neurons (neurons). The perceptron network can be defined as a set of interconnected neurons that produces a result by receiving a series of inputs from the neurons and performing an operation, and if the result exceeds the specified threshold, assigns a value as output. In this type of networks, the inputs of the first layer of neurons are connected to the next layers and it is true at each level until it reaches the output layer (Amini et al., 2011). Several multilayer perceptron algorithms are shown below.

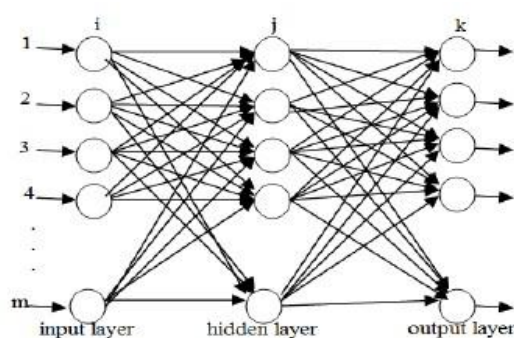


Figure (1), perceptron neural network

### Research Findings

#### Neural network model design

The number of hidden layers of the network, the number of neurons in each layer, learning algorithms, learning rate, performance function, conversion function, data normalization, number of iterations, size

and number of learning samples and experimental sets must be specified to design the neural network model. There is no systematic way to determine the above, and the network usually achieves its best results using trial and error. The proper structure of the neural network in this study has three layers, including the input and output layers and a hidden layer. The number of neurons in the input layer is 15, the hidden layer is 15 and the output layer is 1. The number of layers and the number of hidden layer neurons must be constantly changed to achieve the best neural network system, in order to consider the best network state that gives the best solution. The number of input data of the research includes 570 vectors, of which 70%, ie 400 vectors were used as learning data for network training, 15% for validation of network training and another 15% for network testing (test data). In order to implement the neural network using Matlab software, the multilayer perceptron neural network is implemented with the Tangent Sigmoid transfer function for the hidden layer and the linear function for the output layer.

Input data is first randomly arranged to avoid random order. Randomization is done by randomly shifting numbers and moving them in rows. Random data is then normalized between 0 and 1 to achieve better network performance. The data is provided to the network after being randomized. The general framework of the neural network is shown in the following figure:

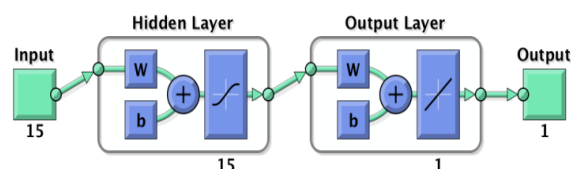


Figure 2: Neural network structure

The maximum number of repetitions for network training is selected 5000 times and the Levenberg - Marquardt learning algorithm. Also, network performance is measured by the Mean Squared Error criterion. Here, the number of repetitions required for the designed network training, using input data, has been 43 times, which was completed in 6 seconds. The characteristics of the neural network are listed in table 2.

Also, the following tables show the proposed weights and numerical values of the neural network.

Matlab software is used to determine the weights assigned to the first layer of input as shown in the table below.

Also, the weights assigned for the first layer bias are as shown in the table below

**Table 2- Specifications of neural network**

Component	Amount or specifications
Training algorithm	Levenberg - Marquardt
Training step limit	5000
Error limit	0.0000001
Hidden layer transfer function	Tangent Sigmoid
Output layer transfer function	Linear

**Table3 - Input Guide**

Input 11	Firm reputation	Input 6	Exchange rate fluctuations	Input 1	Financial stability
Input 12	Profitability	Input 7	Information uncertainty	Input 2	Debt growth rate
Input 13	Capital expenditure	Input 8	Firm life	Input 3	Conservatism
Input 14	Auditing expertise	Input 9	Firm size	Input 4	Financial health
Input 15	Credit risk	Input 10	Firm value	Input 5	Firm growth

**Table (4), weights assigned to the first layer of input**

	Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Input 8	Input 9	Input 10	Input 11	Input 12	Input 13	Input 14	Input 15
1	-0.07	-0.27	-0.38	-0.68	-0.49	-0.78	0.79	0.23	-0.23	-0.09	0.49	-0.33	-0.32	0.15	0.51
2	-0.70	-0.51	0.32	0.49	-0.22	0.56	0.31	-0.87	0.56	0.53	0.04	-0.46	0.21	-0.29	0.62
3	-0.07	-0.48	0.62	0.25	0.08	0.56	-0.44	0.25	-0.06	0.21	0.51	-0.80	-0.26	-0.03	-0.66
4	0.00	0.70	0.27	0.42	0.35	-0.03	0.29	0.16	0.12	-0.73	-0.56	-0.69	-0.11	-0.35	-0.17
5	-0.72	0.07	0.63	1.02	0.70	0.16	-0.36	-0.30	-0.73	0.78	0.01	-0.19	0.70	0.23	-0.25
6	0.86	0.67	0.28	0.12	-0.40	0.43	-0.75	-0.43	-0.40	-0.59	-0.45	0.12	-0.41	0.08	0.15
7	-0.48	0.44	0.21	-0.01	0.68	0.85	0.29	-0.13	-0.23	0.73	0.08	0.71	-0.98	0.31	-0.61
8	-0.33	-0.81	0.38	0.75	0.06	0.07	0.33	0.53	0.56	0.36	0.23	0.37	-0.56	-0.48	0.25
9	0.13	-0.53	-0.10	0.89	0.24	0.17	-0.40	-0.12	0.45	0.19	-0.43	0.34	0.32	-0.86	-0.22
10	0.69	-0.65	0.70	-0.04	0.62	0.34	0.07	-0.65	0.71	-0.68	0.31	-0.06	0.72	-0.95	0.47
11	-0.50	0.51	-0.39	0.47	0.68	-0.18	-0.53	-0.26	-0.28	-0.18	-0.31	0.41	0.66	0.61	0.30
12	0.89	0.48	0.81	0.30	-0.24	-0.61	0.49	0.47	-0.50	-0.10	0.59	0.61	0.74	0.05	-0.09
13	-0.54	0.13	-0.63	0.69	0.31	-0.24	0.60	0.54	-0.53	0.13	-0.60	0.20	-0.13	-0.53	0.10
14	-0.94	0.44	-0.02	-0.46	-0.28	0.07	0.58	0.02	0.16	1.03	-0.67	-0.64	-0.20	0.55	0.06
15	0.65	0.08	-0.32	0.57	-0.12	-0.23	0.10	-0.70	0.66	-0.21	0.63	0.35	0.42	-0.05	0.16



Table (5), weights assigned to the first layer bias

Neurons number	Weight
1	1.7335
2	1.4321
3	1.6911
4	-1.0257
5	0.70675
6	-0.30951
7	-0.02562
8	0.16528
9	-0.1939
10	0.41204
11	-0.62058
12	0.87769
13	-1.357
14	-1.1421
15	1.8305

Furthermore, the weights assigned to the second layer are as follows

Also, the weight assigned for the output layer bias is 0.66637. The results of sensitivity analysis for the designed network are shown in Figure (3).

Furthermore, the mean square error diagram at best for network performance is shown in figure 4

As shown in figure 3, the best network performance was performed in iteration 3, which reported a square error value of 0.1794. The error histogram diagram is shown in Figure 5.

The error distribution is shown in the histogram diagram, that means how much of the data in each set (training, check and test) has an error value equal to that displayed on the x-axis

Table (6), weights assigned to the second layer

neurons number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Weight	-0.18	-0.60	-0.02	-0.39	-0.28	0.27	0.16	-0.46	-0.23	0.51	-0.15	-0.11	0.58	0.23	0.12

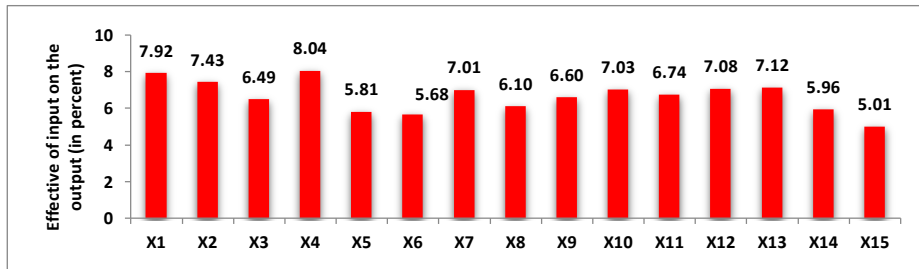


Figure 3- The results of Sensitivity analysis (percentage of effect of independent variables)

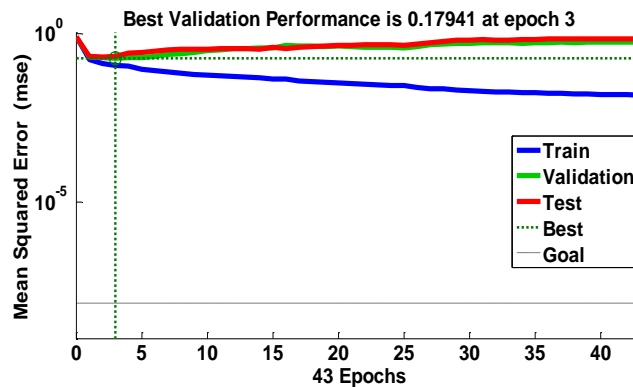


Figure 4- Mean squared error (MSE) diagram

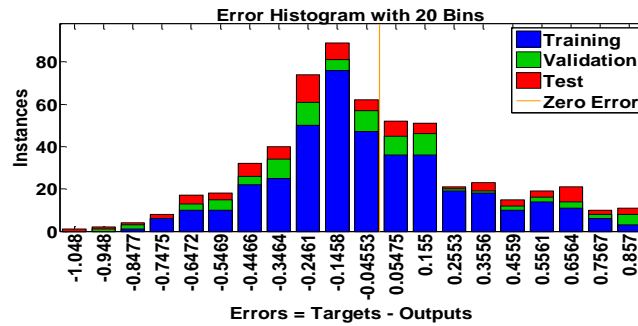


Figure 5- Error histogram diagram

**Neural network prediction error calculation**

Table 7, shows the results of neural network performance and its correct prediction accuracy

Also, the result of accurate network function is shown in two figures 6 and 7

Also, the amount of neural network error in terms of percentage is as follows.

Table7- The results of the accuracy of fiscal discipline prediction

Correct prediction %	Number of correct predictions	The total number of data	Data type
81.75%	327 vectors of 400 vectors	400 vectors	Educational
78.82%	67 vectors of 85 vectors	85 vectors	Validation
77.65%	66 vectors of 85 vectors	85 vectors	Experimental
80.70%	460 vectors of 570 vectors	570 vectors	Total

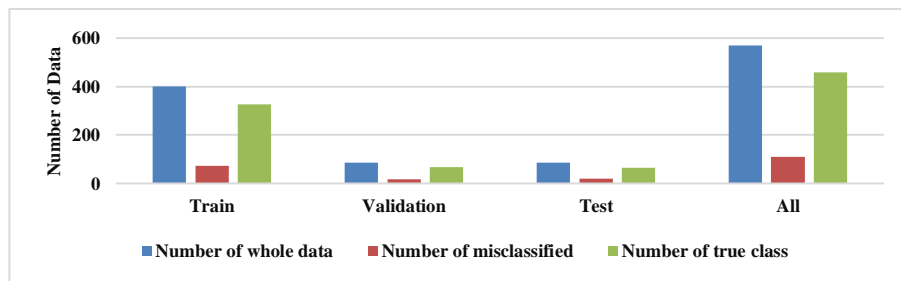


Figure 6: Neural network function diagram

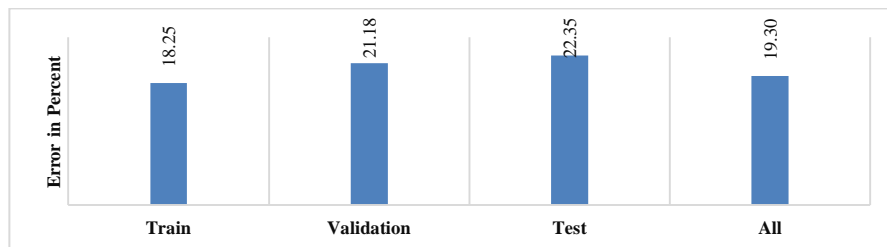


Figure 7: Neural network error diagram in percentage

## **Discussion and Conclusion**

Financial discipline at the corporate level is simply described as the absence of unjustified mistakes and changes in the principles and methods used. Discipline is considered as one of the most important issues for theorists and scientists in different fields, and various and contradictory opinions have been raised in this regard over the years, which confused those involved and even the scholars. Discipline can be examined from various philosophical, theoretical, or managerial dimensions. Also, it is possible to explain a general form of discipline that can be presented to some extent in a precise structure in each of the aforementioned fields. The term discipline has an important position in human societies, and is used as a special indicator - in order to assess the status of societies in relation to each other -. In relation with comparison of organizations with each other, it is believed that organizations that have more discipline in terms of financial dimension in planning and execution can be successful in performing tasks. Thus, this study was carried out aimed to identify and explain the factors affecting the fiscal discipline of companies listed on the Tehran Stock Exchange using the artificial neural network method. The present study seeks to help managers of listed companies in order to establish discipline in the financial structure and accounting and to help users of financial statements to effectively use the information of companies. In this regard, the effective factors on the fiscal discipline of listed companies were identified and examined using the neural network method and using various variables identified.

According to the results of this study, the most important factors affecting fiscal discipline in companies listed on the stock exchange include corporate information uncertainty, conservatism, firm growth, exchange rate fluctuations, firm life, financial health, firm size, company reputation, financial stability, debt growth rate, auditing expertise, capital expenditures, profitability, credit risk and firm value. The results show that, among the identified variables, the most important factors in the success of companies' fiscal discipline are financial health, financial stability, debt growth rate, capital expenditures, profitability, firm value and information uncertainty, respectively. In this regard, according to the research results, financial health is the most important factor in the fiscal discipline of listed companies. There is a significant relationship between financial health and

the discussion of continuity of activity, bankruptcy, financial distress and the qualitative characteristics of accounting information such as relevance and reliability. In fact, financial health can be defined as the profitability and continuity of the economic unit. Thus, considering that financial health is one of the effective components of fiscal discipline, it can be expected that if the fiscal discipline of listed companies is realized, these companies will be away from bankruptcy and guarantee the profitability and continuity of their company's activities. The results of this part are consistent with the results reported by Piacenza and Tourati (2010). According to these researchers, financial health is of the utmost importance in creating fiscal discipline. According to the findings, financial stability is the second factor affecting fiscal discipline. Companies with financial stability are never in trouble in financing their projects and can effectively achieve their goals and ensure profitability for their company. Companies will never have trouble financing their projects and can achieve their goals in an effective way and ensure profitability for their company. The results of this part of the study are consistent with the results reported by Neto (2020). According to Neto (2020), financial stability plays an undeniable role in fiscal discipline. Furthermore, according to the results, the debt growth rate is very important in fiscal discipline. A company with a high debt growth rate faces serious risks in the long run and faces many problems if the growth curve is upward. Thus, if there are fiscal discipline and a reduction in debt growth rates, listed companies can deal with these risks. Regarding the similarity of this part of the research with the researches, it should be said that Kea (2018), like this study, believes that the debt growth rate has a significant effect on fiscal discipline. The results show that capital expenditures are the fourth most important factor in the fiscal discipline of listed companies. Reasonable and appropriate capital expenditures are necessary to achieve the goals of a company. According to one definition of fiscal discipline, a company needs to know where and how much to spend its capital. Thus, the way of management of capital expenditures in the listed companies in order to achieve fiscal discipline is very important. Regarding the sharing of the results of this part of the study with other researches, it should be noted that Monty and Papanji (2001) considered the capital expenditure of the company as an important

factor in fiscal discipline. Also, according to the results of research findings, exchange rate fluctuations have a significant effect on fiscal discipline. Traditionally, in the financial literature, this view is based on that there is a significant relationship between fixed exchange rate regimes with increased fiscal discipline. The findings of this part of the study are consistent with the results reported by Jalles et al. (2016). According to the findings of both studies, exchange rate fluctuations have a significant effect on fiscal discipline. According to the results reported by Jalles et al. (2016), strong political environments which are characterized by a long horizon and high cohesion among policymakers are associated with better performance and fiscal discipline. In conclusion, it can be concluded that the issue of fiscal indiscipline for companies, especially companies listed on the stock exchange, which also has a significant effect on the attraction of foreign direct investment, may create many problems, including negative reactions of investors to these reports. Nowadays, special attention should be paid to the issue of fiscal discipline due to the expansion of the capital market and the entry of a wide range of different segments of society to invest in this market. On the other hand, many new investors are classified as uninformed investors and may be associated with negative reactions to reports of financial indiscipline and irreparable damage. Therefore, paying attention to this issue by senior managers of companies is considered as one of the most important issues facing them.

### **Recommendations**

According to the results of this study, the financial health of listed companies is considered as the most important factor in companies' fiscal discipline. Thus, according to the results of this study, the financial health of listed companies is considered as the most important factor in fiscal discipline of companies. Therefore, it is suggested in this study that special attention is paid to the fact that it has significant effects on firm performance and stock prices and stock market feedback.

The results of this study show that corporate credit risk is considered as one of the most important factors in the success of fiscal discipline. Therefore, it is suggested to financial managers that special attention be paid to this important factor in the current economic conditions. Also, legislators can reduce corporate

credit risk by enacting accounts receivable laws, and take effective steps to improve the financial situation of companies. Also, according to the results, corporate information uncertainty has been another important factor in the success of fiscal discipline. Thus, it is suggested to the managers of Tehran Stock Exchange and the Supreme Council of the Stock Exchange to develop requirements and laws to improve the quality and reliability of companies' accounting information to take advantage of these requirements to improve the Iranian capital market and efficiency. According to the results, profit management has a significant effect on fiscal discipline in companies. Thus, according to the implementation of Article 44 of the Constitution of the Islamic Republic of Iran in relation to privatization, it is recommended to the managers of the privatization organization that reduce the costs of representation and profit management by transferring the shares of listed companies to capital and facilitating the oversight of corporate governance by providing accurate disclosure of information and transparency of information. Also, given that exchange rate fluctuations have a significant effect on fiscal discipline it is recommended that central bank and government managers help stabilize the exchange rate through integrated economic management, control of liquidity growth, and thus targeting to reduce inflation, providing a suitable context for stable economic activity and with the arrival of large foreign investments in the country.

### **Suggestions for future research**

It is recommended that researchers identify and examine the effective factors on fiscal discipline in other statistical communities, such as all industries of Tehran Stock Exchange as well as non-listed companies. Also, researchers can design models for fiscal discipline using other statistical methods. Furthermore, researchers can use other important variables in the research as regulatory variables issued by auditors in relation to the weakness of corporate internal controls.

### **Research Limitations**

Given that the present study has been carried out on specific companies with the conditions related to the admission of these companies in the stock market, it seems necessary to mention that care should be taken to generalize the results to other companies.

Furthermore, given that few studies have been conducted in this field, especially at the level of listed companies is one of the most important points and limitations in relation to this research due to the novelty of the subject of fiscal discipline. Also, the poor performance of the Iranian capital market, as an intervening factor can have a significant effect on the research results that it cannot be controlled by the researcher. This issue is considered as one of the bottlenecks in the implementation of capital market-based research, including this study.

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