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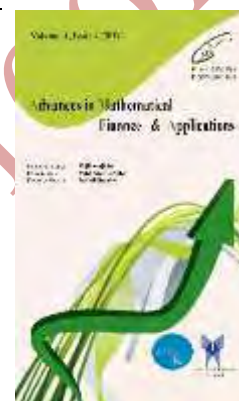
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Applied-Research Paper

## Providing a model of earning transparency with emphasis on the criteria of the governance system and performance: an artificial intelligence approach

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### ABSTRACT

The present study is aimed to present a model of earnings transparency with an artificial intelligence approach in companies listed on the Tehran Stock Exchange (TSE). For this purpose, the data of 167 companies during the years 2011 to 2018 were used to test the research hypotheses. Variable selection test performed using Lasso's artificial intelligence algorithm showed that among the criteria of the audit committee's independence management system, the non-executive managers ratio, gender diversity and among the performance criteria, the ratio of cash holding in the company, operating profit margin and accounts receivable ratio had the highest effect to explain the earnings transparency of companies and also to predict the earnings transparency of the companies in the next year, the LARS algorithm method was used. The results of prediction showed the high power of Lars artificial intelligence algorithm to predict the earnings transparency of the companies listed on TSE.

Keywords: Earnings Transparency, Corporate governance and performance criteria, Artificial Intelligence Approach

## 1 Introduction

In today's turbulent world, where organizations and societies are facing dramatic changes in environment and technology, and consequently global trade and globalization, the ability to achieve the desired and expected level of performance is in a state of ambiguity. In this way, what can ensure the growing life of organizations is the existence of a powerful and efficient management system. In other words, in the case of authority and capability of the company's management pillar, good performance of organizations in the current situation can be expected [15]. Information transparency is very important as it emphasizes providing appropriate information for decision making and ensuring that investors are not misled [13].

It is obvious that proper transparency of financial information reduces the agency problem among managers and shareholders and also improves the decision-making of users of financial statements. Recent developments in the accounting profession, such as the increasing importance of accountability and the enactment of mandatory rules for public corporations to restore public confidence in capital markets, have led to important changes, such as a greater focus on

financial reporting accuracy and transparency. One of the most important sources of information for making financial decisions is the reported extra-organizational financial statements of companies. If these reports are not properly transparent and do not well represent all relevant, important and effective information, it is likely that the financial decisions of shareholders and investors will not lead to the creation of maximum wealth for them. For example, the lack of accurate reporting of company profits and its low transparency are among the factors that can affect the dividends of companies and the return of shareholders. Lack of the transparency of reported profit creates information risk [11]. Adequate transparency of information can build trust among shareholders and provide greater capital market efficiency. Therefore, conducting research on transparency issues is of particular importance and necessity. Accordingly, profit transparency has been analysed in this study.

## 2 Theoretical Foundations And Research Background

Earning transparency is the process of taking informed steps within the accepted accounting principles to bring the reported profit to the expected level and considering three incentives, including stock, contractual and legal markets. Transparency in financial information, on the one hand, assures small shareholders that they will always receive reliable information about the value of the company and that major shareholders and managers do not seek to squander their rights. On the other hand, it encourages managers to try to increase the value of the company instead of pursuing short-term personal interests [4].

Financial reporting, through the transparent disclosure of corporate financial information, can reduce information asymmetries, optimally allocate resources (making the right choice instead of making the wrong choice), and improve the performance of the company. Playing this accounting role also contributes to economic development. One of the key elements of financial reporting is net profit. Net income reported in the financial statements is one of the most important criteria for evaluating the performance of a business unit, which is always used by a wide range of users such as investors, shareholders, financial managers, stock market analysts and tax rates. Managers' discretion in using the principles of realization, compliance and estimation and the manipulations made by them are among the factors that affect profit transparency. Many managers may favor the company for reasons such as retaining the company and receiving rewards, willingly or unwillingly. Hence, the financial information published in the financial statements, especially the accounting profit, is the basis of many decisions. It is opaque and ambiguous (Haghighat and Alavi [7]).

Having a good corporate governance system can help companies gain the trust of investors and encourage them to invest. The two main goals of corporate governance are to reduce the risk of the enterprise by improving and promoting transparency and accountability, as well as improving the long-term efficiency of the organization by preventing authoritarianism and irresponsibility of executive management [3]. The Audit Committee is one of the mechanisms that is expected to be effective in safeguarding the interests of the various groups that use accounting information. In recent years, developed countries have witnessed the rapid emergence and development of audit committees. Expansion of international operations, intensification of activities of joint stock companies to gain competitive advantages, increase of debts due to environmental damage, role and impact of management estimates in the figures in financial statements and reports, lack of a

valid basis for examining management claims regarding the adequacy of internal control structure by independent auditors, the expansion of the use of computer systems and, consequently, the difficulty of overseeing the control of these systems have intensified the process of establishing and employing an audit committee. One of the tasks of the audit committee is to ensure the presentation of reliable reports, or reliable financial reporting in companies [2]. Considering that the criteria of the governance system have been introduced as a regulatory arm for profit transparency in this study, it seeks to analyse the factors affecting profit transparency and also to predict profit transparency by artificial intelligence method. The reason for the use of artificial intelligence is the high efficiency of algorithms to analyse the high volume of variables and also having the ability to be trained and tested to provide a model.

The following structures are very important to our journals.

Min Oh et al. [14] examine the relationship between corporate sustainability management and profit transparency. Based on previous studies showing that sustainable management activities reduce firms' profit and risk management and increase firm value, this study shows that firms with effective sustainability management have high profit transparency.

Iordache Irina Diana [8] to study the transparency of accounting information in financial markets, an international perspective. In this study, they analyze the issue of transparency of accounting information at the level of listed inputs in financial markets, as a solution to the process of optimizing management strategies to increase the confidence of information users and attract investors. This study includes the analysis of the financial statements of 120 companies listed in 8 capital markets. In making the sample, it was assumed that the degree of transparency of accounting information provided by companies is directly proportional to their weight in the structure of stock indices. Finally, [10] stock indices were analyzed. The results of the study showed that in order to ensure the transparency of accounting information and regular reporting requirements, the mentioned institutions should adjust their organization and communications in accordance with good governance practices and strong management system and accounting rules. Accounting information also comes from the way in which the management of each entity knows how to take responsibility and that optimal information system based on the profit-cost ratio and also ensuring that all shareholders and investors are in equal proportion of information create.

According to results Moghaddam and Aslani [12], the cash component of earnings is more persistent than accruals and it can be used to predict future earnings. Therefore, it is suggested that cash dividend component to predict future earnings. In addition, managers should pay attention to the cash component of earnings in their decisions made on the amount of optimal cash fund because this component can positively affect future earnings. Moreover, the cash flow component of earnings cannot be used to predict future return on stock. Therefore, investors are recommended not to rely on the cash component of earnings in their investments, This is because even if corporates have considerable cash funds, their shares will not necessarily be a suitable option for investment and they should take other factors into account.

Salimi [18] in the one research After designing and testing hypotheses for each hypothesis, it was concluded that the relationship between transparency of accounting information and auditing costs is established at all levels of the company and also at the corporate level companies with low financial leverage. If the relation between transparency of accounting information and auditing costs at the corporate level with high financial leverage is high, there is no significant linear relationship between high cash and low cash

Izi and et al. [9] the results indicate that there is a significant negative relationship between the behavioral characteristics of managers and the reporting quality financial information. Also, there is a positive and significant relationship between value content of accounting information and reporting quality of financial information

## 2.1 Research Background

Fakhari and RezaeiPiteNouei [4] analysed the impact of the audit committee on the company's information environment in the period of 4 years before and after the approval of internal control instructions in 2012, during the years 2008 to 2015. The results of a survey of 41 companies that formed an audit committee after the approval of internal control instructions in 2012, through combined data using the panel method, indicated that there is a positive and significant relationship between the existence of the audit committee and the company's information environment. In other words, with the establishment of the audit committee in companies, their information environment has become more transparent and the value of the index has increased.

Azadi et al. [3] examined the role of independence and financial expertise of the audit committee in disclosing financial information. The results of this study indicated that the role of the independent audit committee and the financial expertise of the members of the audit committee in disclosing information leads to reporting credibility, reducing information asymmetry and information and financial transparency. It is such that it can be employed to achieve competitive advantage and achieve the long-term goals of companies.

Vakilifard [19] examined the effect of corporate governance level on the transparency of accounting profit and cost of capital in companies listed in the Tehran Stock Exchange using data from 107 companies. The first hypothesis of the research was that: the higher the level of corporate governance, the greater the transparency of accounting profit. The second hypothesis of the research was that: the higher the level of corporate governance, the lower the cost of capital. The results of testing the research hypotheses showed that the higher the level of corporate governance, the greater the transparency of accounting profits and the lower the cost of capital.

Malau [11] examined the effect of earnings persistence and earnings transparency on company performance with corporate governance as moderating variable. The results showed that the earnings persistency variable has a positive and significant effect on company performance. Earnings transparency also has a positive and significant effect on company performance. Corporate governance, as a moderating variable, enhances the impact of earnings persistency and earnings transparency on company performance. The size and life of the company also have a positive and significant effect on the company's performance.

Nawafly&Alarussi [13] examined the impact of board characteristics, audit committee characteristics, and external auditor on disclosure quality of financial reporting. The statistical population included 150 non-financial companies listed in the Malaysian Stock Exchange. Findings showed that the board characteristics and audit committee characteristics have a positive and significant effect on the quality of financial reporting disclosure.

Wang et al. [20] conducted a study entitled "relations among audit committee establishment, information transparency and earnings quality: evidence from simultaneous equation models". The results showed that the establishment of audit committees has a positive relationship with



information transparency and earnings quality. The result of the simultaneous equation model showed that there are positive interactions among audit committee establishment, information transparency, and earnings quality.

### 3 Research Hypotheses

Proper governance encourages managers to maximize the value and benefits of the company instead of pursuing their own goals. In this study, considering the role and importance of the governance system as a supervisory arm of the company as well as the theoretical foundations and research of Malau [11], Nawafly&Alarussi [13], and Wang et al. [20], the following hypotheses are developed:

Hypothesis 1: The governance system criteria (audit committee characteristics) affect the profit transparency of companies with an artificial intelligence approach.

Hypothesis 2: The governance system criteria (managerial characteristics) affect the profit transparency of companies with an artificial intelligence approach.

Third hypothesis: The performance criteria are effective on earnings transparency of companies with artificial intelligence approach.

### 4 Research Methodology

The present study is applied and uses a quasi-experimental design and post-hoc approach. In order for the statistical sample to be a suitable representative of the statistical population, the systematic elimination method has been used. For this purpose, the following 4 criteria are considered and if the company has met all the criteria, it is selected as the research sample and the rest are removed.

1) In terms of increasing comparability, the company's fiscal year should be ended on March 20, and the company should not have changed its fiscal year and type of activity during the period 2011 to 2018.

2) In terms of separate reporting structure that investment and financial intermediary companies (leasing and insurance and holdings and banks and financial institutions) have, they are excluded from the sample.

3) Their financial information should be available in the period 2011 to 2018.

4) Statistical sample companies should have been active in the period under review.

According to the above conditions, 167 companies have been selected to test research hypotheses over a period of 8 years.

**Table 1:** Statistical Sampling Method

Total number of listed companies at the end of 2018	513
Criteria:	
Number of companies that were not active in the stock market during the period of 2011-2018	185
Number of companies listed on the stock exchange since 2011	54
Number of companies in the list of holding, investments, financial intermediation, banking or leasing companies	58
Number of companies that have changed their fiscal year during the research period	40
Number of companies whose information is not available during the research peirod	9
Number of sample companies	167

#### 4.1 Overview Of The Proposed Research Method

First, criteria that have a high relationship and correlation with profit transparency are selected using Lasso method. Then, companies' profit transparency is predicted using the LARS method. Finally, with the help of the dependent variable of real profit transparency and comparing it with the predicted profit transparency, the prediction error of the test data for the model is obtained.

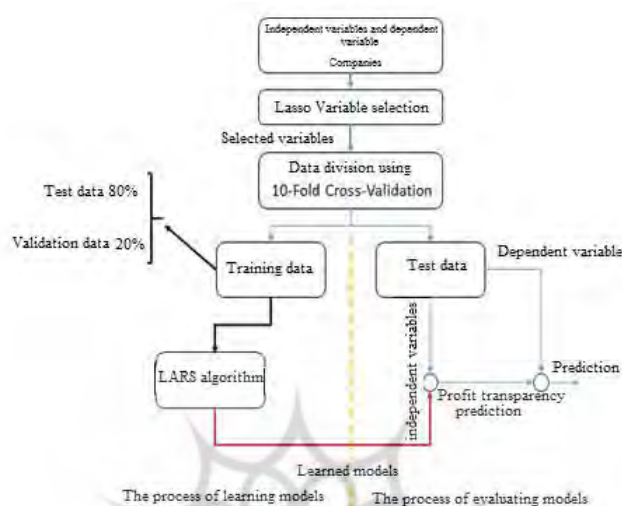


Fig. 1: Overview Of The Proposed Method

## 4.2 Research Variables

In this study, the governance system criteria are considered as the initial independent variables:

Table 2: Research variables

Variables	Operational definitions
	Governance system criteria
Board size	The number of members of the company's board of directors is the basis for calculating the size of the board of directors.
Existence of internal auditor	If the company has an internal audit unit, Dummy variable is 1 and otherwise, zero.
The dual role of the CEO	If the CEO is the Chairman or Vice-Chairman of the Board of Directors, the variable is 1 and otherwise, zero.
Ratio of non-executive managers	The number of non-executive board members is the basis for calculating the total number of board members.
Percentage of institutional owners	According to the definition of paragraph 27 of Article 1 of the Securities Market Law, banks, companies and any person who holds more than 5% of the issued shares is considered as a criterion for calculating an institutional shareholder.
Family ownership	If the company is family owned, Dummy variable is 1 and otherwise, zero.
Specialty of the board of directors	The ratio of managers with financial expertise to the total number of board members is the basis of calculation.
Gender diversity of the board	The ratio of female board members to all board members is the basis of calculation.
Independence of the audit committee	The number of non-executive members of the audit committee divided by the total number of members is the basis of calculation.

Type of ownership	If the company is more than 50% owned by the government, artificial variable is 1 and otherwise, zero.
Expertise of the audit committee	The number of members of the audit committee with financial expertise divided by the total number of members is the basis of calculation.
Change of CEO	If the CEO has changed compared to the previous year, artificial variable is 1 and otherwise, zero.
Size of the audit committee	The number of members of the audit committee is the basis of calculation.

- Quick ratio: It is obtained by dividing current assets minus goods inventory by current debt.
- Current ratio: It is obtained by dividing current assets by current debt.
- Cash ratio holding in the company: The figure obtained of dividing cash and short-term investment by total assets.
- Operating cash ratio: It is calculated by dividing the cash from operations by total assets.
- Inventory ratio: The ratio of inventory to total assets
- Accounts receivable ratio: The ratio of accounts receivable to total assets
- Sales to total assets ratio: It is obtained by the ratio of sales to total assets.
- Operating profit margin: Operating profit margin is obtained by dividing operating profit by sales.
- Return on equity: Return on equity is obtained by dividing net profit by equity w.
- Price to earnings per share ratio: It is obtained by dividing the stock price at the end of the year by earnings per share.
- Q-Tobin ratio: The sum of the company's market value and the book value of debt divided by total assets.
- Sales growth: The difference between this year's sales and the previous year is divided by the sales of the previous year.
- Return on assets: Return on assets is obtained by dividing the net profit by the total assets.
- Return on sales: Return on sales is obtained by dividing net profit by sales.
- Stock returns:

To calculate stock returns, the following method is used.

$$\frac{\text{Market value of the company at the end of year} - \text{The market value of the company at the beginning of year} + \text{Approved dividend} - \text{capital increase via cash and claims}}{\text{Market value of the company at the beginning of year}}$$

- Current debt to total assets ratio: Current debt to total assets
- Long-term debt ratio: Long-term debt to total assets
- Working capital ratio: (current assets - current debts) / assets



- Firm size: To calculate this variable, the natural logarithm of total assets is used
- Fixed asset turnover ratio: The ratio of fixed assets to total assets
- Company growth: It is obtained by dividing the market value of the company by the book value of the company
- Dividend ratio: To calculate this variable, the company's dividend is divided by net profit
- Financial leverage: It is obtained by dividing total debt by total assets.

Systematic risk: Beta is the stock of the intensity of changes in the return of the required share relative to the market; and the following formula is used.

$$\frac{\text{cov (return market, stock)}}{\text{var (market return)}}$$

Dependent variable (profit transparency)

The criteria for measuring profit transparency in this study according to Bart et al. (2009) is as follows (Bart et al. 2009, Haghigat and Alavi, 2013):

$$R_{i,t} = \alpha_0 + \frac{\alpha_1 E_{i,t}}{P_{i,t-1}} + \frac{\alpha_2 \Delta E_{i,t}}{P_{i,t-1}} + \varepsilon_{i,t}$$

In the above model, the variables are:

$R_{i,t}$  = annual return on stock in year t;

$E_{i,t}$  = earnings per share before the unusual items of company i in year t;

$E_{i,t\Delta}$  = change in earnings per share before unusual items from year t-1 to t;

$P_{i,t-1}$  = stock price at the end of the year t-1.

## 5 Research Findings

### 5.1 Descriptive Statistics

Descriptive statistics indices (central and dispersion indices) are presented in Table 2 to summarize the data to obtain an overview of the sample and the relationships between research variables. In the study of the distribution of a statistical population, the agency value around which the dimensions are distributed is called the central value, and any numerical criterion that represents the center of the data set is called the center-orientation criterion. Mean and median are the most common criteria for center-orientation. Standard deviation, as one of the scattering indicators, shows how far the average data is from the mean.

**Table 3:** Descriptive Statistics

Variable	Average	Middle	Max	Min	SD	Elongation	Chubby
Transparency in earning	0.63	0.70	0.99	0.0	0.27	-0.77	-0.56
The dual role of the CEO	0.26	0	1	0	0.44	-0.84	1.08
Board size	5.03	5	7	5	0.26	53.36	7.43
Ratio of non-executive managers	0.66	0.6	1	0	0.19	0.02	-0.26
Percentage of institutional owners	71.85	76	99.57	0	18.83	1.18	-1.18
Size of the audit committee	2.14	3	5	0	1.46	-1.08	-0.58
Independence of the Audit Committee	0.25	0.33	1	0	0.23	2.42	1.09
Expertise of the Audit Committee	0.50	0.67	1	0	0.39	-1.53	-0.13

Existence of internal auditor	0.75	1	1	0	0.43	-0.62	-1.17
Gender diversity of board members	0.01	0	0.4	0	0.06	12.27	3.53
Financial expertise of board members	0.12	0.2	0.8	0	0.13	0.97	0.84
Change CEO	0.27	0	1	0	0.45	-1.01	0.99
Family ownership	0.18	0	1	0	0.38	0.72	1.65
Financial Leverage	.59	0.61	2.08	0.06	0.21	3.50	0.60
Debt to total assets ratio	0.52	0.53	1.37	0.05	0.19	0.18	0.20
Systematic risk	0.58	0.55	5.94	-2.82	0.90	2.92	0.66
The ratio of long-term debt to total as- sets	0.80	0.04	1.37	0	0.9	40.34	4.61
Ratio of current assets to total assets	0.67	0.70	0.97	0.06	0.19	-0.39	-0.62
Working capital ratio	1.51	1.28	13.15	0.21	1.09	37.18	4.96
size of the company	14.10	13.97	19.31	10.16	1.44	1.08	0.63
Instant ratio	0.97	0.84	10.43	0.08	0.80	50.17	5.67
Ratio of sales to total assets	0.91	0.77	5.14	0.05	0.55	9.56	2.35
Ratio of accounts receivable to total as- sets	0.28	0.26	0.92	0	0.17	-0.00	0.68
Proportion of fixed assets to total assets	0.26	0.21	0.93	0.01	0.18	0.63	1.04
Operatingearning margin	0.15	0.13	0.97	-2.79	0.24	33.89	-3.36
Return on assets	0.10	0.08	0.62	-0.40	0.13	1.76	0.047
Return on equity	0.15	0.22	9.48	-	23.42	855.30	-27.64
Stock returns	0.49	0.18	8.59	-66	0.98	13.81	2.95
Operational cash ratio	0.11	0.09	0.64	-0.46	0.12	1.62	0.54

### 5.2 Variable Selection Method Of The Lasso Operator Algorithm For Selecting The Minimum Absolute Value

In the linear regression model, it is assumed that we have N observations of the results (y response variable) and p predictor variable (or property). Predicting the response variable based on the observed data (from the predictor variables) is the main goal in linear regression. The prediction operation may also be applied to data that was not present during the modeling (test data). To solve the problem, the Lasso<sup>1</sup> model is first introduced. Lasso algorithm is an algorithm in the field of linear regression and obtains the following linear regression model coefficients.

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_px_p \tag{1}$$

Where,  $x_1, x_2, \dots, x_p$  is the independent variable related to a sample and y is the dependent variable. Also,  $\beta_j, j = 1, \dots, p$  are the coefficients of the regression model when p is the number of independent variables. These parameters are sometimes called regression model coefficients. The Lasso algorithm uses the following objective function to estimate the coefficients of the above regression model

$$\hat{\beta}^{lasso} = \underset{\beta}{\operatorname{argmin}} \left\{ \sum_{i=1}^N \left( y_i - \beta_0 - \sum_{j=1}^p x_{ij}\beta_j \right)^2 \right\} \tag{2}$$

Subject to  $\sum_{j=1}^p |\beta_j| \leq t$

Where N is the number of instances of instruction? Lasso uses a combination of two methods of reducing the dimension of variables and minimizing the sum of modified squares. Thus, using a

<sup>1</sup>Least absolute shrinkage and selection operator

penalty function on the sum of the absolute values of the regression model coefficients, the number of parameters is controlled. All training samples are placed line by line in the X matrix. Here,  $X_{ij}$  indicates the value of the  $j^{\text{th}}$  variable for the  $i^{\text{th}}$  training sample. In the above relation, it is assumed that  $n > p$ , i.e. the number of samples is more than the number of independent variables. Lasso is a convex programming. To solve this problem, it is written in Lagrange form

$$\hat{\beta}^{\text{lasso}} = \underset{\beta}{\operatorname{argmin}} \left\{ \frac{1}{2} \sum_{i=1}^N (y_i - \beta_0 - \sum_{j=1}^p x_{ij} \beta_j)^2 + \lambda \sum_{j=1}^p |\beta_j| \right\} \quad (3)$$

In the above equation, the penalty term  $(\sum_{i=1}^p |\beta_i|)$  simply represents the sum of the absolute values of the values of the regression coefficients. As can be seen in the programming problem, the function tries to reduce the value of this sum or, in other words, tries to increase the number of zeros in the coefficients. In this relation,  $\lambda$  is a regulating parameter, which means that if its value is equal to zero, the model will become a normal regression and all variables will be present, and if its value increases, the number of independent variables in the model will decrease. Therefore, by selecting  $\infty$  for  $\lambda$ , there are practically no variables in the model. The determination of the value for this parameter is usually done by cross-validation method. The value of  $\lambda$  is highly dependent on the size of the weights and may be smaller or even close to zero in certain problems. What is important is the role of this parameter in the exchange between the number of selected features and the regression model error. So, in addition to solving the problem and finding regression coefficients, Lasso tries to reduce the number of independent variables. Using quadratic programming problem, it estimates the regression coefficients using the training data. Thus, Lasso includes a penalty kick ( $\lambda$ ) that determines how many features are retained. Using the cross-validation method to select the  $\lambda$  coefficient ensures that the model will be well generalized in future data samples.

In the first phase, first, the learning data is divided into two training and validation data using the 5-fold cross validation method. The purpose of this phase is to determine the parameter  $\lambda$  of the lasso algorithm, the importance of which was discussed in the previous sections. In this regard, 300 values between zero and 0.05 are selected for the  $\lambda$  parameter with equal intervals. Now, which of these values can be used on data that have not been trained in the past and can also be suitable for future data. In the first iteration (Fold 1), using linear data for each parameter  $\lambda$ , the regression coefficients of the linear model of (1) are calculated by lasso. Finally, the following 7 variables have been selected by Lasso algorithm as primary variables for prediction.

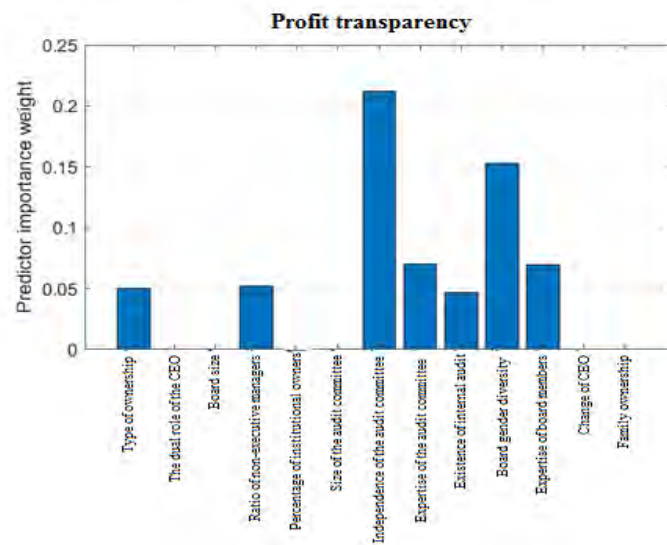


Fig. 2: Results Of Lasso Variable Selection Algorithm (Governance system criteria)

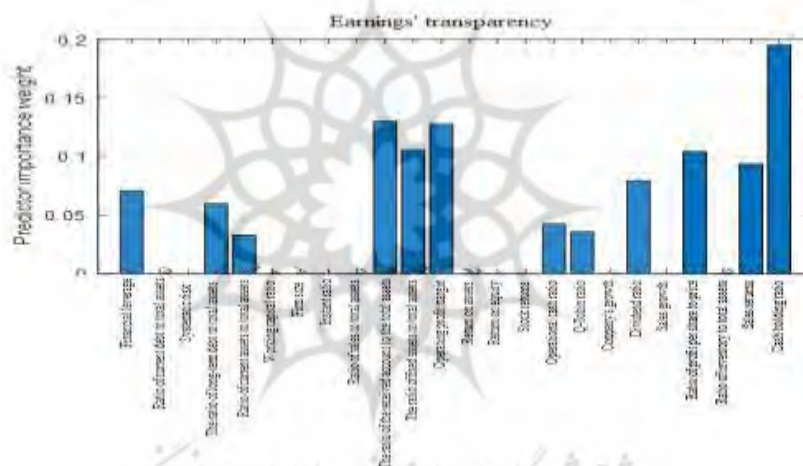


Fig. 3: Results Of Lasso Variable Selection Algorithm (Performance Criteria)

### 5.3 LARS Algorithm For Prediction

In this method, as in the front-end property selection method, all the coefficients of  $\beta_j$  are first set at zero and the independent variable that has the highest correlation with the dependent variable ( $x_{j_1}$ ) is selected. Then, we take the longest step that can be taken in the direction of this variable as long as another variable, such as  $x_{j_2}$ , has the same correlation with the current residual. At this point, instead of continuing in the direction of  $x_{j_1}$ , LARS continues in a direction that has an angle equal to both variables - until the third variable ( $x_{j_3}$ ) enters the "maximum correlation set". Then, we continue in the direction of equal angle between the three variables of  $x_{j_1}$ ,  $x_{j_2}$ , and  $x_{j_3}$ , which is called Least Angle Direction. This problem is shown in Fig. 4 and Fig. 5.

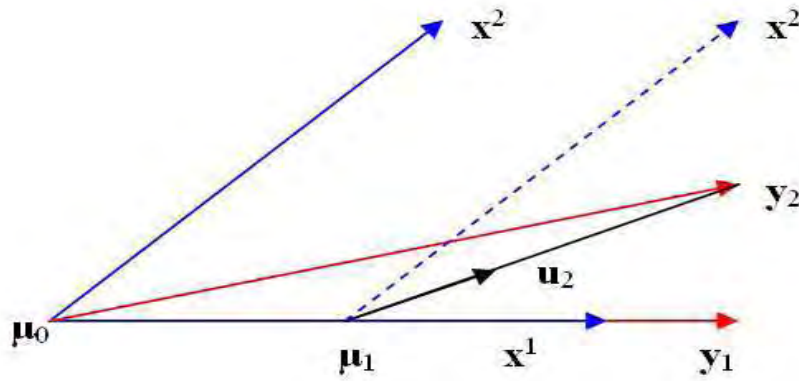


Fig. 4: Equal Angle Between The Two Variables

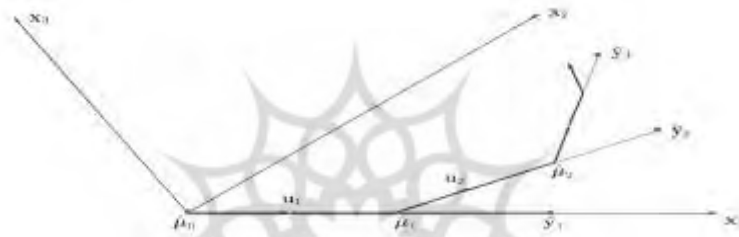


Fig. 5: Geometric Procedure Of LARS Algorithm

In this algorithm, we only need  $m$  steps, where  $m$  is the number of independent variables.

### 5.3.1 LARS Implementation Steps

Suppose  $r_j$  is the correlation value between the independent variable  $X_j$  and the dependent variable  $Y$  and the matrix  $R_X$  contains the correlation value of the variables  $X_1, X_2, \dots, X_d$ . Here,  $X_m$  has the highest value of absolute value of correlation with the dependent variable  $Y$  and  $S_m = \text{sign}(r_m)$ . Thus,  $X_m$  is the first variable selected to be added to the set of active variables and we have to change the current prediction of  $\hat{\mu} \leftarrow 0$  by moving in the direction of  $S_m X_m$ . The magnitude of this change will be  $\gamma$ , such that it is obtained according to the correlation between the variables. By obtaining  $\gamma$ , the LARS algorithm simultaneously calculates  $\gamma$  for the first variable selected to be added to the model, and also determines the second variable that will be added to the model.

Now, the LARS algorithm is summarized with respect to the  $r_j$  correlation between  $X_j$  and  $Y$  and the  $R_X$  correlation matrix of the variables as follows:

1.  $A = \emptyset, S_A = \emptyset$
2.  $m = \arg \max |r_j|, s_m = \text{sign} \{r_m\}, r = s_m r_m$



3.  $A \leftarrow A \cup \{m\}, \quad s_m \leftarrow s_A \cup \{s_m\}$
4. Calculate  $a == [1'_A (D_A R_A D_A)^{-1} 1_A]^{-\frac{1}{2}}$  where  $D_A = \text{diag}(s_A), R_A \subset R_A$   
 Calculate  $w_A = a (D_A R_A D_A)^{-1} 1_A$   
 and for  $j \in A^c : a_j = (D_A r_{ij})' w_A$

Where,  $r_{jA}$  is the correlation vector between  $X_j$  and active variables. (Note: when we have only one active variable:  $a = 1, w = 1, a_j = r_{jm}$ )

5. For  $j \in A^c$  Calculate :  $\gamma_j^+ = \frac{r - r_j}{a - a_j}, \quad \gamma_j^- = \frac{r + r_j}{a + a_j}$

$$\gamma_j = \min(\gamma_j^+, \gamma_j^-), \quad \gamma = \min(\gamma_j, j \in A^c)$$

If  $m$  is the indicator of  $\arg \min$ , we have  $\gamma = \gamma_m$ .

If  $\gamma_m = \gamma_m^+$ , then  $s_m = +1$  else  $s_m = -1$

For  $j \in A^c$  Modify  $r \leftarrow r - \gamma a, r_j \leftarrow r_j - \gamma a_j$

Repeat steps 3, 4, and 5.

### 5.3.2 Criteria For Evaluating Profit Transparency Prediction

The LARS algorithm is used to predict the dependent variable of profit transparency. To evaluate the models, three evaluation criteria called mean absolute error (MAE), mean squared error (MSE), and symmetric mean absolute percentage error (SMAPE) have been used, which are calculated using the following equations.

$$MSE = \frac{1}{n} \sum_{i=1}^n (y_i - d_i)^2 \tag{4}$$

$$MAE = \frac{1}{n} \sum_{i=1}^n |y_i - d_i| \tag{5}$$

$$SMAPE = \frac{1}{n} \frac{\sum_{i=1}^n |y_i - d_i|}{\sum_{i=1}^n (y_i + d_i)} \tag{6}$$

In the above relations,  $y_i$  and  $d_i$  are the dependent variable of real profit transparency and the dependent variable of predicted by the algorithms for the  $i^{th}$  year-company, respectively. Here,  $n$  is the number of company-years (in the learning or evaluation phase),  $\bar{y}$  and  $\bar{d}$  are average of the real and predicted dependent variable, respectively.

### 5.4 Results Of Profit Transparency Prediction

After executing the model learning process, in order to check how successfully the model has completed the learning process, the same training data previously given to the algorithm to learn its model parameters are again fed to the model with learned parameters as an evaluation example. The only difference is that this time the model predicts the value of the dependent variable, then mean of the 10 error criteria of the 10-fold cross validation method is calculated and reported in Table 3. The closer these errors are to zero, the better the models are trained. It can be seen that the error of profit transparency prediction of this year is less than next year.

**Table 4:** Average Errors To Evaluate The Training Rate Of The Models For Different Years

MAE	Current year			Next year		
Fold	MAE	MSE	SMAPE	MAE	MSE	SMAPE
1	0.2315	0.0772	0.1942	0.2334	0.0794	0.1837
2	0.2297	0.0769	0.1820	0.2329	0.0789	0.1837
3	0.2280	0.0755	0.1811	0.2294	0.0769	0.1793
4	0.2268	0.0756	0.1798	0.2309	0.0780	0.1803
5	0.2298	0.0761	0.1844	0.2366	0.0808	0.1865
6	0.2309	0.0772	0.1835	0.2331	0.0785	0.1829
7	0.2307	0.0775	0.1835	0.2345	0.0798	0.1845
8	0.2293	0.0761	0.1832	0.2373	0.0809	0.1865
9	0.2259	0.0742	0.1784	0.2312	0.0783	0.1815
10	0.2294	0.0762	0.1831	0.2336	0.0792	0.1843
Mean	0.2292	0.0763	0.1823	0.2333	0.0791	0.1834

But what we have to worry about is the occurrence of a phenomenon called overfitting. For this reason, to examine the generality of the proposed model, the error rate is obtained for predicting the dependent variable of profit transparency for the company-years of test data (companies-years that have been excluded by the 10-fold cross validation method in each iteration and the algorithms have not seen them yet). For each error criterion, 10 errors are reported, each of which is reported by a 10-fold cross validation method, the average of which is shown in Table 4. Similar to the previous one, it is concluded that the obtained model is general, that is, it works well for companies-years that have not been seen before. Also, the problem of overfitting has not occurred, since the difference between the error criteria of training and evaluation data is small. As expected in all algorithms, the prediction error of this year is less than next year. As a result, the farther the years are from the current year, the lower the prediction accuracy.

**Table 5:** Average Errors To Evaluate The Prediction Power Of Models For Different Years

MAE	Current year			Next year		
Fold	MAE	MSE	SMAPE	MAE	MSE	SMAPE
1	0.2123	0.0688	0.1710	0.2351	0.0776	0.1818
2	0.2246	0.0709	0.1835	0.2400	0.0815	0.1875
3	0.2404	0.0843	0.1926	0.2589	0.1006	0.2059
4	0.2436	0.0842	0.1942	0.2548	0.1006	0.2059
5	0.2319	0.0786	0.1775	0.2118	0.0644	0.1618
6	0.2175	0.0688	0.1731	0.2354	0.0854	0.1860
7	0.2142	0.0687	0.1685	0.2270	0.0737	0.1776
8	0.2314	0.0785	0.1790	0.2029	0.0639	0.1604
9	0.2562	0.0961	0.2126	0.2498	0.0875	0.1981
10	0.2334	0.0771	0.1837	0.2348	0.0792	0.1817
Mean	0.2306	0.0773	0.1836	0.2351	0.0803	0.1850

After performing the model learning process, in order to check how successful the model has gone through the learning process, the same training data previously given to the algorithm to learn its model parameters are again given to the model with learned parameters as test data, with the difference that this time the model predicts the value of the dependent variable. Then, the

mean of the 10 error criteria of the 10-point mutual validation method is calculated and reported in Table 3. The closer these errors are to zero, the better the models learn. It can be seen that the error of forecasting earning transparency of current year is less than next year.

**Table 6:** Mean Errors To Evaluate The Training Rate Of Models For Different Years Of Accounting Performance Criteria

MAE	Current year			Next year		
Fold	MAE	MSE	SMAPE	MAE	MSE	SMAPE
1	0.2265	0.0736	0.1791	0.2256	0.0726	0.1761
2	0.2237	0.0722	0.1761	0.2272	0.0737	0.1777
3	0.2242	0.0728	0.1771	0.2229	0.0711	0.1728
4	0.2218	0.0717	0.1746	0.2220	0.0708	0.1718
5	0.2267	0.0734	0.1809	0.2299	0.0754	0.1807
6	0.2282	0.0743	0.1804	0.2244	0.0722	0.1746
7	0.2265	0.0735	0.1790	0.2272	0.0738	0.1773
8	0.2241	0.0729	0.1781	0.2295	0.0750	0.1789
9	0.2213	0.0709	0.1738	0.2266	0.0738	0.1766
10	0.2259	0.0732	0.1793	0.2278	0.0741	0.1783
Mean	0.2249	0.0728	0.1778	0.2263	0.0733	0.1765

**Table 7:** Mean Errors To Evaluate The Predictive Power Of Models For Different Years Of Accounting Performance Criteria

MAE	Current year			Next year		
Fold	MAE	MSE	SMAPE	MAE	MSE	SMAPE
1	0.2121	0.674	0.1667	0.2326	0.0810	0.1807
2	0.2373	0.0814	0.1936	0.2260	0.0711	0.1748
3	0.2325	0.0751	0.1859	0.2566	0.0939	0.2058
4	0.2515	0.0856	0.2011	0.2625	0.0969	0.2124
5	0.2177	0.0703	0.1647	0.2036	0.0551	0.1550
6	0.1988	0.0611	0.1572	0.2465	0.0847	0.1935
7	0.2132	0.0685	0.1696	0.2198	0.0694	0.1706
8	0.2371	0.0741	0.1839	0.1994	0.0588	0.1554
9	0.2561	0.0936	0.2093	0.2224	0.0700	0.1716
10	0.2238	0.0720	0.1735	0.2162	0.0674	0.1655
Mean	0.2280	0.0749	0.1805	0.2286	0.0748	0.1785

## 6 Conclusion And Recommendations

One of the issues that can help investors make decisions is the existence of appropriate tools and models to assess the financial condition and status of companies. One of the tools used to decide to invest is forecasting models. The acceleration of economic activities and events has had many positive and negative consequences. One of the most important negative consequences of these changes is increased competition for financial resources and limited access to profits by businesses and enterprises. In the absence of proper oversight and controls, the quality of financial reporting and profit transparency of the company may not be reliable. Profit as one of the most important accounting indicators has always been the focus of investors and creditors for various purposes such as stock valuation and corporate management performance as well as to improve investment decisions [1]. Due to the importance of identifying the factors affecting earnings transparency in this study, appropriate indicators were identified to explain accounting earnings

transparency and also predict it in companies listed on the Tehran Stock Exchange with an approach based on artificial intelligence and corporate governance criteria. For this purpose, the data of 167 companies during the years 2011 to 2018 were used. The results showed that among the corporate governance criteria, the independence of the audit committee, the proportion of non-executive directors, gender diversity, the expertise of the audit committee and the financial expertise of the board members, the existence of an internal auditor have been selected as the highest criteria related to earnings' transparency. According to [8], audit committees have become an important tool for companies to reliably monitor the financial reporting process, and the audit committee must have its own independent sources of information to perform its oversight tasks optimally. The Audit Committee is one of the mechanisms that is expected to be effective in safeguarding the interests of the various groups that use accounting information. The auditing committee, through oversight of the financial reporting process, including the internal control system and the use of accepted accounting principles, as well as overseeing the performance of independent auditors and internal auditors, reduces intentional and inadvertent errors in accounting measurements and disclosures of financially significant items, fraud, and illegal management practices [16]. One of the tasks of the audit committee is to ensure reliable reporting, or reliable financial reporting of companies. Consistent with this research, the results obtained from the study of Banayi (2013) also showed that the three characteristics of independence and expertise and the tenure of the audit committee affect preventing illegal actions, improving the financial reporting process and providing transparent and reliable financial reporting information. Kamyabi and Bojmehrani (2016) showed that there was no significant positive relationship between the expertise and size of the audit committee and the quality of disclosure. Among the criteria of managerial characteristics, the criteria of expertise of board members, gender diversity of the board of directors, the ratio of non-executive managers affect earnings' transparency, which can be said that strong corporate governance is to control opportunistic behaviors of management and reduce such behaviors. It can be expected that a strong corporate governance increase the transparency of accounting profits [19]. The result of this hypothesis is similar to the research of [19] who stated that the higher the level of corporate governance, the greater the transparency of accounting profits. Also, to predict the transparency of the company's profit in the coming year, the LARS artificial intelligence algorithm method was used. The forecast results indicate the high power of the artificial intelligence algorithm to predict earnings' transparency using selected criteria in companies listed on the Tehran Stock Exchange. The results of this research are in line with the results of [3, 5, 17, 19, 20].

The results also showed that among the financial performance criteria, the variables of financial leverage, long-term debt to total assets ratio, ratio of current assets to total assets, ratio of accounts receivable to total assets, ratio of fixed assets to total assets, operating profit margin, operating cash ratio, Q-Tobin ratio, dividend ratio, price to earnings per share ratio, sales return, ratio of cash held in the company have been selected as the top criteria that have a strong relationship with earnings' transparency. This is in line with theoretical literature and normative views. This means that if companies provide transparent financial information to capital market participants, especially financial providers, they are more able to evaluate that company based on published information.

The results of this study can be applied by company managers so that by predicting earnings'

transparency in companies and working on the factors affecting it, they can take steps to manage shareholder capital attraction, reduce the risk of financial crises and help investors to avoid large losses in stock market. Given the important role of the audit committee in corporate governance, shareholders and board members are suggested to become familiar with the important oversight role of these members and also these members become more familiar with their duties and roles to be able to play a more effective role in corporate governance. Given the characteristics of women, such as tact, accuracy, patience and other such characteristics, it seems that the presence of women in the board of directors has a positive role in the transparency of corporate profits. However, one of the biggest and most important obstacles for women is attitudes that act as an obstacle to their progress. There are still managers who do not want to leave some important positions to women. Another issue is the reluctance of women to hold managerial positions as they age, while men of all ages want more responsibility and control over the results of their work, so this issue has increased the presence of men on the board of directors of companies. It seems that by preparing the ground for the presence of women in key positions, better results can be achieved. It is suggested that in the continuation and completion of this research, by adding different industries to the statistical population, we achieve more accurate results and use the results of this research in compiling and approving the regulations of the company's corporate governance in Tehran Stock Exchange. It is suggested that investors pay due attention to the specifics of the audit committee when analyzing financial statements. Also, Tehran Stock Exchange Organization is suggested to put more pressure on the implementation of the audit committee in companies. Therefore, not all companies listed on the Tehran Stock Exchange have disclosed activities related to the audit committee.

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Uncorrected Proof

