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## Designing a New Model of Effective Financial Factors on TEPIX with Structural Equation Model and Fuzzy Approach

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**Abstract:** The goal of this research was designing a new model of effective financial factors on TEPIX (stock price index in Tehran stock exchange) with structural equation model and fuzzy approach. Based on, it was reviewed literature of stock price index in special. Data collection instruments were documents, interviews and questionnaire as nonexperimental survey research, to designing model with emphasize on structural equation model and fuzzy with using SPSS v.15, Lisrel v.8.7 and FuzzyTECH v.5.61 software's. The results showed in the entire factors of the structural equation model, EPS have the most Effect on TEPIX and return assets for fuzzy modeling. Finally, it is presented concluding, discussion, implications for managers and directions for further research.

**Key words:** Fuzzy, EPS, statement of disclosure, financial, TEPIX

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### INTRODUCTION

The price variation of stock market is a very dynamic system that has intrigued analysis from a number of disciplines. Two common analytical approaches are fundamental analysis and technical analysis. A fundamental analysis relies on the statistics of the macroeconomics data such as interest rates, money supply, inflationary rates and foreign exchange rates as well as the basic financial status of the company. After taking all these factors into account, the analyst will then make a decision of selling or buying a stock. A technical analysis is based on the historical financial time-series data. However, financial time series exhibit quite complicated patterns (for example, trends, abrupt changes and volatility clustering) and such series are often non-stationary, whereby a variable has no clear tendency to move to a fixed value or a linear trend (Cheng and Liu, 2008).

Stock is a measure and main index of country's economic. Its importance is criteria by some views and by studying each of them we can understand its rule on economic, private institutes and sometimes government need private institutes for the needed capital on their

project and it is the reason for buying this share. When the sharing happened, a document is given to the stock holder which is named share. Therefore, according to the changing in stock price and proper evaluation, the organization of stock exchange is made and according to the offer and demand, the companies' acceptable stock are priced and transacted.

This is important because little invests to be inclined on big actions and the money in private part is guided toward the individual and national profits. Index scholar is as temperature which shows the economics' situation of the capital market. Decreasing of shares' price shows the economic stagnancy and its increasing shows economic improvement in America and its first using of shares happened at 1884. Totally shares price index in all capital market of the world is as one of the most important measurement for stock exchange and attract importance and attention. Perhaps the most important reason for this attention is that mentioned index are governed by shares movement of all companies or special groups of existed companies and therefore it makes possible to study the way and measure of valuable movement in shares market.

Extending the theories and capital inventions at these lately decades was according to the general movement of

market and increasing the calculation and study of these price index (Pakdin, 2008). Main and important using of price index calculation of all market's output or specified variables of market in a special time and output using which is calculated, is as a basis for judgment about different portfolio. The main portfolio theory action is that investors are able to have more output in comparison to the market and random selection of the most extended shares or loan documents of the all market. Therefore a manager with a better action should be better than the market. Therefore shares index or loan documents can be a criteria for judgment about action of investment managers. Also some kind of portfolio risks can be compared on the basis of risky index. Price index are also to improve and create special portfolio for the most of the manager's investment is to get more output than market output in long time. In this way, investment in portfolio is a simple way which is compatible by portfolio market. This idea comes to create the index boxes which aims to follow the market index action during the time; the price of shares shows the economic situation of company. Therefore stock index shows the activity and situation of whole economy. Analyzers of the valuable documents, portfolio managers and other economy in chargers, use the market index to study those variables which have effect on all the prices of the charges. Technological analyzers are those who likes indicator and believe that historical charges of prices can be used to predict the lately movement. According to the portfolio hypothesis and capital behavior it's described risk in relation to the capital that have risk and it is just a systematic risk. This risk describes the price of the purpose output with the output of the relationship market portfolio. Therefore it is necessary, when the systematic risk of a risky in relation with capital and, its output in index of the comprehensive market is calculated (Frank and Brown, 2000). Oscillation of shares price in the entire world is routine, not just normal, because the shares price and others kind of valuable documents shows all internal and external effective variables, therefore when special changing come into existence in effective variables, its reflection will be observed on shares price (Hamedian, 2000).

This is a necessity which guides different research. Amiri *et al.* (2008) conclude that there is a meaningful relationship between the price of share and it is divided output. Also Jamshidi (1998) in a research got the liner relationship between outcome and shares price in the market of Tehran stock exchange. Hamedian (2000) concluded that psychic and political variables are high importance on decision making by the stockholders at Tehran stock. Ebadi (2002) concluded in this study dissertation that shares distribution has more effect on

share price and long time loan has more effect than bank loan on the shares output. Rapach (2001) described that big shock has effect on shares price. Bordman and Claude (2000) find out the size of the company has negative effect on shares price action; also different period has positive effect on share price. Bartram (2007) concludes that changing of risk rate on shares price and cash is similar. Gammill and James (1988) concluded that most of the countries try to use of the Arbitrage opportunities. Bordman and Claude (2000) study the effect of different variables on the shares price and approved its effect on the depended variable. Therefore, these kind of the company size, golden shares and kind of the industry and period are different which at recent research we approved them as internal variables. Bihanot study the effect of government intrusion of shares price index and approved its affection. Therefore he insists on one side of the political-governmental variables. Olgun and Ozdemir (2007) concluded that Sand P 500 has permanently effect on the shares price. Brown and Yucel (2002) found out relationship between oil price and economic variables can be asymmetrical. Keane and Parsad (1996) found that increasing of oil price cause to decreasing the employment in short time and increasing the employment in long time. Ewing and Thompson (2007) get that the price of oil cause to the consumer price. Baharumshah *et al.* (2007) found that long term. Income hasn't meaningful elasticity as regards to the shares price on the demand of market's money. Sadorsky and Henriques (2007) get out the effect of the shares at technology companies has more effect on the price of the shares of energy (not oil) than the shock of the price oil.

Quah and Srinivasan (1999) know five effective variables on the shares price as risk, growing, cash, momentum and output. Cheng and Liu (2008) create a model of shares in the basis of fuzzy and using the important and effective variable by the 97.6% accuracy, as its pattern is accepted by the Taiwan electronic companies in Taiwan stock. Starks and Wei (2004) concluded that disclosure of the most of the foreign currency may cause to financial problem in growing opportunities. Bartram (2007) studies the effect of the companies' cash and shares price on changing on foreign currency and concluded that the effect of foreign currency is as the cash. Hammoudeh and Choi (2006) studies in long time, the effect of Persian golf market shock -which was the result of America oil market and effect of S and P 500 and bonds. Then they concluded that the bonds price has directly influence on market. Jones and Kaul (1996) studies the effect of oil price shocks on equity prices in Japan, America, Canada and Britain concluded that just in oil price stock, America

and Canada has effect on real money is completely clear. Nandha and Hammoudeh (2007) study this systematic risk and oil price variable between 15 countries in the Pacific Ocean and concluded that the effective variable on oil price has more changes in comparison to the market systematic risk of the capital on target country. Randall and Lie (2007) gets in research, price before the big days can be related with those days' actions as 1st January. Peter and Zhang (2007) found in their study, the accountant predict share price movements. Bartram (2007) study the share price and cash of the company and their influence on foreign currency and concluded factories whose share price is affected during the time less and also effect of the risk rate shares price and cash is as some as that one according to the economic factors.

Therefore to the mentioned subjects describe the importance and rule of the stock exchange to improve the country economic situation. In this research financial effective variables on TEPIX are studying. Therefore, the purpose of the mentioned research is to study and designing model of financial effective variables on TEPIX with structural equation model and fuzzy approach in a conceptual model.

## **MATERIALS AND METHODS**

About the researches way there are different idea and views (Zohori, 1999). According to this subject and four theoretical views and methods, extending and improving the existing theory, comparing the different theoretical views, study the special phenomenon by using the different theoretical views and finally study the repetitive and well-document (this research was done before) in anew station and conditions (Feldman, 2004), this research is prescriptive is at fourth group.

Statistical population with 500 people at this research includes experts who are aquatinted to stock exchange and analyzing on stock price and helped the researchers to collection the data.

In order to sampling at behavioral science, there are some ways such as simple random sampling, organized random sampling, Taxonomic sampling, racemose sampling is stages sampling (Azar and Momeni, 2001).

To choose statistical sampling at this research we received response 150.

Its area is about stock exchange, especially about price index, this study was conducted 2008 and its local domain was Tehran stock exchange.

There are four variables according to their rule in answering the questions or hypothesizes test that includes EPS, ratio price to income, return assets and statement of disclosure are related to financial factors variable and dependent variable TEPIX.

In order to critically evaluating and validity the used factors (Hult and Ferrell, 1997) in questionnaire, there is some study and testes on factors by the experts and professors, them after adjusting, final questionnaire will be used.

Method of collecting data is necessary at this research and it is as, the questionnaire is made, it is given at first reference and the statistical society are given necessary explanation, then at second reference they gather the information. After collection them, all of them are encoding, then inter to the Lisrel, FuzzyTECH and SPSS software's, so they are arranged and the models are designed.

There are different ways to validating the measurement tools that one of them is asking the question of experts (Bazargan, 1998; Sarokhani, 2003). These question is valuable because the parts of the measurable variables are taken from research literature and in other word the related experts are purchase in capital stock. Indeed on questionnaire planning, it is given to the experts and professors on a forward testing, then after receiving their reforming views, final questionnaire planning it will be used for collection information.

In order to determining the validity of the measurement tool, there are different and various ways that one of them is examination of the internal consistency (Conca *et al.*, 2004). Internal consistency of the measurement tool can be measured by Cronbach alpha index (Cronbach, 1951). This is the way which is used in most of the research (Peterson, 1994) however the minimum and acceptable measurement should be 0.7 but 0.6 or till 0.55 is acceptable too (Van de Ven and Ferry, 1979; Nunnally, 1978). In recent research the Cronbach alpha index is 0.86, therefore its durability is confirmed.

## **RESULTS**

**The extraction of the structural equation model explaining of effective financial factors on TEPIX:** As regards to the conceptual model of study, the structural equation model of four main variables explaining the effective financial factors on TEPIX of the sample is presented by the Lisrel software's output. It can be said that among the various indexes of assignment of the propriety of structural equation model, RMSEA is the most well-known and can evaluate efficiently the propriety of structural equation model.

In the present study, the RMSEA is 0.00, respectively. So, its model has efficient propriety and its generality is confirmed due to  $RMSEA \leq 0.10$ . The four visible EPS, ratio price to income, return assets and statement of disclosure variables can also explain 94% of the main invisible variables i.e., TEPIX in subjects.

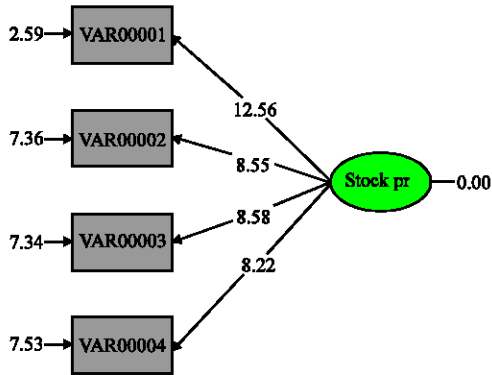


Fig. 1: The t-value coefficients of the relationship between the four variables and TEPIX

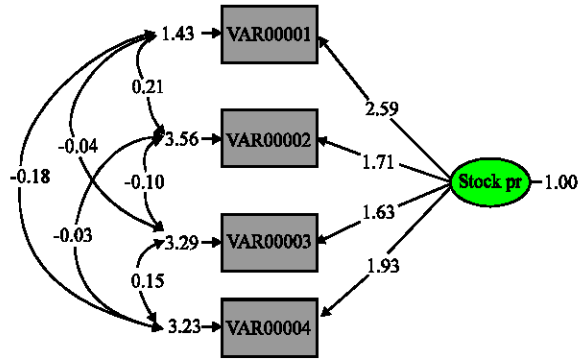


Fig. 3: The vector (non-standard) coefficients of the relationship between the four variables and TEPIX

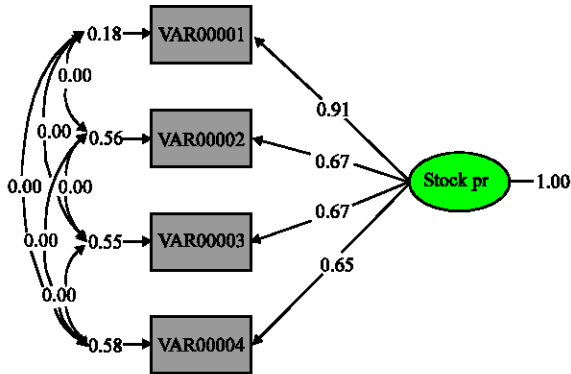


Fig. 2: The standard coefficients of the relationship between the four variables and TEPIX

In Fig. 1, it is showed the t-value coefficient relationship between the variables and TEPIX of the sample. In structural equation, the variables have two kinds of explaining relationship for the main variable that in this research is TEPIX including direct and indirect. As it is considered, all of the direct and indirect relationships are confirmed because none of them have red color. In Fig. 2 and 3, they are presented the direct and indirect standard regression coefficient and (non-standard) evaluation coefficient of the structural equation model coordinating the TEPIX of the sample.

The structural equation explaining the relationship between the variables and TEPIX of the sample included four visible variables and an invisible variable. Table 1 is presented the explanations related to visible and invisible variables, direct standard and non-standard coefficients, the t-value of the structural equation.

As it is showed in the Table 1 and also in Fig. 1, it is confirmed all of the direct and indirect relationships between the visible variables and TEPIX according to the Lisrel output. So, it is required in extraction of the structural equation to enter only the confirmed direct

and indirect relationships. The general structural equation model of the interactive relationship between variables (direct and indirect effects) includes:

Structural equation model = (direct effects) + (indirect effects)

It is showed in Fig. 2 (standard coefficients) that indirect relationships coefficients of each visible variable is zero. So, the structural equation model explaining the TEPIX in terms of the standard coefficients (only direct relationships) includes:

$$TEPIX = (0.91var1 + 0.67 var2 + 0.67 var3 + 0.65 var4) + (0)$$

And the structural equation model explaining the TEPIX in terms of the non-standard coefficients includes:

$$TEPIX = (2.59 var_1 + 1.71 var_2 + 1.63 var_3 + 1.93 var_4) + ((0.21 var_1 \times 1.71 var_2) + (-0.04 var_1 \times 1.63 var_3) + (-0.18 var_1 \times 1.93 var_4) + (-0.10 var_2 \times 1.63 var_3) + (-0.03 var_2 \times 1.93 var_4) + 0.15 var_3 \times 1.93 var_4)$$

**Collection data**

**Fuzzy modeling:** In fuzzy modeling there are different ways about knowing their kinds which can be mentioned as two following:

- Fuzzy model parameter, while data are classic  $y = a + b_1x_1 + b_2x_2 + \dots + b_kx_k$
- Classic model parameter, while data are fuzzy:
  - Classic data dependent variable and independent data are classic
  - Fuzzy data dependent variable and independent data are classic
  - Fuzzy data dependent variable and independent data are fuzzy

Table 1: The variables and direct coefficients of the structural equation model

Invisible variable	Visible variables	Symbol of visible variables	t-value	Standard coefficients	None-standard coefficients	Confirm/reject model	Confirm/reject relations
TEPIX	EPS	Var1	12.56	0.91	2.59	RMSEA = 0.000	Confirm
	Ratio price to income	Var2	8.55	0.67	1.71		Confirm
	Return assets	Var3	8.58	0.67	1.63		Confirm
	Statement of disclosure	Var4	8.22	0.65	1.93		Model was confirm

**Tests of fuzzy hypothesis:** Fuzzy hypothesis tests can be divided in to four parts:

- Usual hypothesis and observations are fuzzy:  
 $H_0 : \mu = \mu_0$   
 $H_1 : \mu \neq \mu_0$
- Usual hypothesis and observations are usual but used dependencies are fuzzy
- Fuzzy hypothesis, but observations are usual  
 $H_0 : \tilde{\mu} = \tilde{\mu}_0$   
 $H_1 : \tilde{\mu} \neq \tilde{\mu}_0$
- Fuzzy hypothesis, but observations are fuzzy too  
 $H_0 : \mu = \mu_0$   
 $H_1 : \mu \neq \mu_0$

**Definitions**

**Fuzzy:** Most of the time gathered information for some reason isn't very exactly (crisp) and is along with lack of certainty, that can be modeling as Fuzzy model.

- **Membership function:** Is a function which describe X variable at [0,1]:  
 $\mu(x) : x \rightarrow [0,1]$
- **Normal Fuzzy number:**  $\tilde{a}$  is told as normal Fuzzy number which its membership function is equally to one in accordance to some points
- **Fuzzy number:** A fuzzy number  $\tilde{a}$  is a fuzzy convex subset of the real line satisfying the following conditions:
  - $\mu_{\tilde{a}}(x)$  is piecewise continuous
  - $\mu_{\tilde{a}}(x)$  is normalized, that is, there exists  $m \in \mathfrak{R}$  with  $\mu_{\tilde{a}}(m) = 1$ , where m is called the mean value of  $\tilde{a}$

**Triangular fuzzy number  $\tilde{a}$ :** A triangular fuzzy number  $\tilde{a}$  can be defined by a triplet  $(a_1, a_2, a_3)$  (Table 2). Its conceptual schema and mathematical form are shown by Eq. 1:

$$\mu_{\tilde{a}}(x) = \begin{cases} 0, & x < a_1 \\ \frac{x - a_1}{a_2 - a_1}, & a_1 < x \leq a_2 \\ \frac{a_3 - x}{a_3 - a_2}, & a_2 < x \leq a_3 \\ 0, & a_3 < x \end{cases} \quad (1)$$

Table 2: Triangular and trapezoidal fuzzy number  $\tilde{a}$

A trapezoidal fuzzy number $\tilde{a}$	A triangular fuzzy number $\tilde{a}$
Eq. 2	Eq. 1

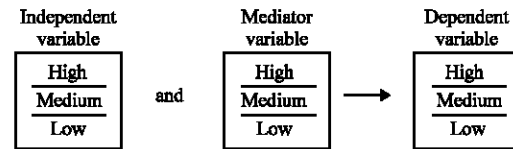


Fig. 4: Research variable fuzzy tools

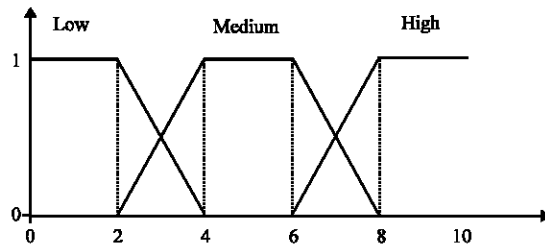


Fig. 5: Presenting high, medium and low fuzzy set at linguistic variables

$$\mu_{\tilde{a}}(x) = \begin{cases} 0, & x \leq a_1 \\ \frac{x - a_1}{a_2 - a_1}, & a_1 < x \leq a_2 \\ 1, & a_2 < x < a_3 \\ \frac{a_3 - x}{a_3 - a_2}, & a_3 < x \leq a_4 \\ 0, & a_4 > x \end{cases} \quad (2)$$

A triangular fuzzy number  $\tilde{a}$  in the universe of discourse X that conforms to this definition has been shown in Fig. 4.

**Trapezoidal fuzzy number  $\tilde{a}$ :** A trapezoidal fuzzy number  $\tilde{a}$  can be defined by quadruplet  $(a_1, a_2, a_3, a_4)$ . Its conceptual schema and mathematical form are shown by equation.

A trapezoidal fuzzy number  $\tilde{a}$  in the universe of discourse X that conforms to this definition has been shown in Fig. 5.

Table 3: Dependent, mediator, independent linguistic variables information

No. replier	Independent linguistic variable				Independent variable b, ...	Mediator linguistic variable				Score of mediator A	Dependent linguistic variable			
	Independent variable a	Low	Medium	High		Low	Medium	High	Mediator variable b		Snare	Low	Medium	High
1	7.6	0	0.2	0.8	.	6.9	0	0.55	0.45	.	6.3	0	0.85	0.15
2	6.8	0	0.6	0.4	.	6.9	0	0.55	0.45	.	7.0	0	0.50	0.50
3	6.6	0	0.7	0.3	.	6.7	0	0.65	0.35	.	6.5	0	0.75	0.25
....	.	.	.	.	.	.	.	.	.	.	.	.	.	.
150	7.6	0	0.2	0.8	.	6.9	0	0.55	0.45	.	6.3	0	0.85	0.15

Table 4: Hypothesis and their confirmation

No. of repliers	Hypothesis No.			
	AA...A	AA...B	....	CC...C
1	1	2	....	N <sup>n</sup>
1	0.05	0.31	....	0
2	0.09	0.09	....	0
....	.	.	....	.
Collection the columns	Σ	Σ	Σ	Σ

Table 5: Fuzzy inference

Repliers No.	Independent linguistic variable	Mediator linguistic variable	Prior result (Min)	Related hypothesis at table	Result (TEPIX)	Degree of hypothesis accuracy	Degree of rules accuracy
1	Low	0	0	CC...C	Low	10.76	0
				CC...B	Medium	2.76	0
				....	High	0.00	0
		Medium	0.55	...	Low	0.24	0
				...	Medium	3.18	0
				...	High	0.16	0
		High	0.45	...	Low	0.00	0
				...	Medium	0.16	0
				AA...A	High	0.04	0
....	....	....	....	....	....	....	....

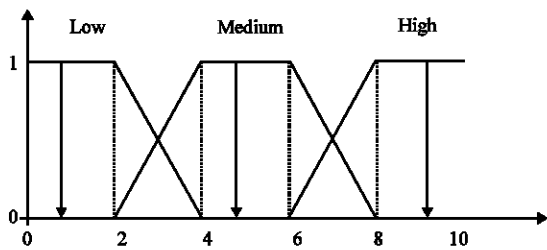


Fig. 6: Pattern's value for linguistics' variables

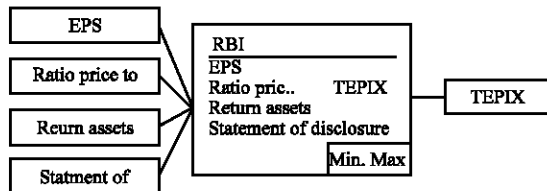


Fig. 7: Conceptual model

**Test of fuzzy hypothesis:** In order to designing model effective financial factors on TEPIX, fuzzy hypothesis is used special question what is model of effective financial factors on TEPIX with fuzzy approach?

At first fuzzy tools at linguistic variable were determined (Fig. 6). Then the variable were described at fuzzy sets that are shown at Fig. 7.

Gathered data for per of the research variable are turned in a table level to fuzzy.

According to the independent linguistic variables, mediator and dependent, the number of the studying hypothesis is equal to N<sup>n</sup> that N is count division in fuzzy tools for linguistic variables and n is numbers of the variables. These hypotheses and the numbers of the upper affected are coming at table number two to emphasize on hypothesis (Table 3).

It necessary to mention that involved variables are shown with summarizing sign. Therefore from the left it's toward dependent, mediator and dependent variable.

Also alphabet ABC shows high, medium (average) and low properties. According to the most of the columns collection it can be understand that, its accuracy is more than the other.

In order to be sure of the fuzzy hypothesis testing at above table we use fuzzy inference, which come follow as summary (Table 4).

By fuzzy concluding, we evaluate TEPIX that for every one of the repliers and the maximum of the accuracy of per rules in fuzzy tools of research variables in relation with independent variable (Table 5).

After fuzzy evaluation and normalize them considering the maximum point of the membership obedient is according to the natural movement to determine the pattern's value (Table 6).

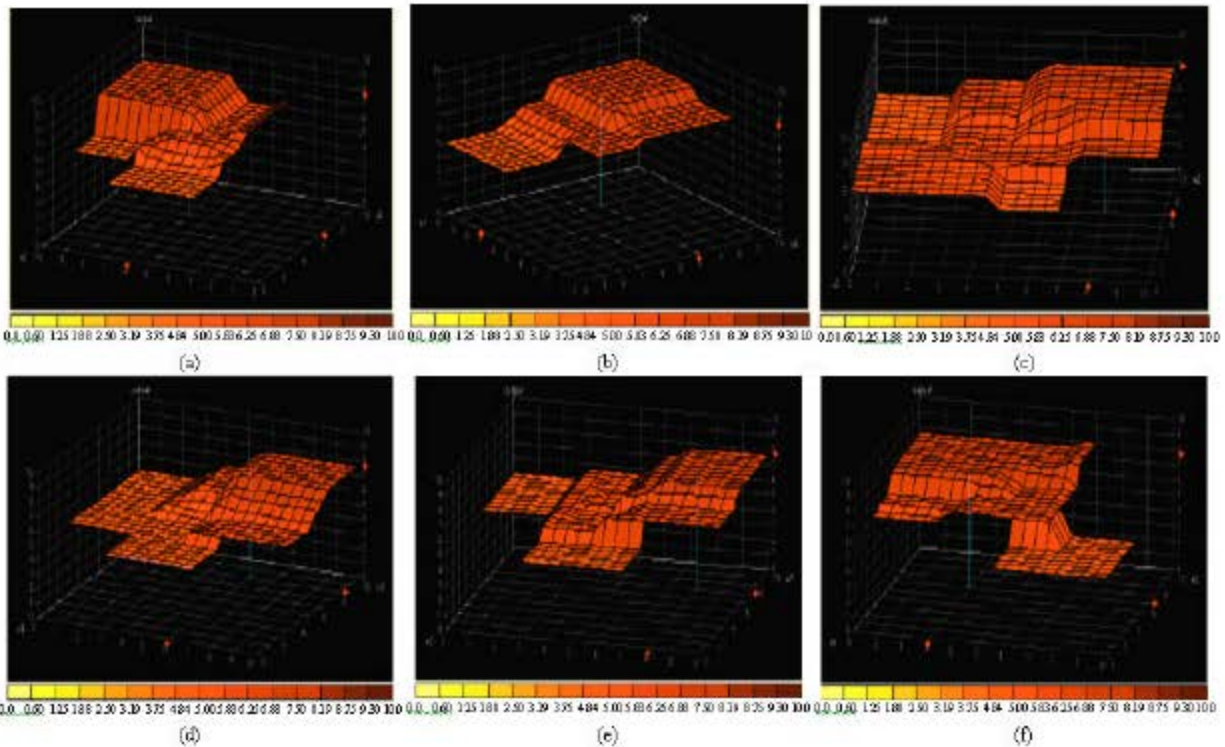


Fig. 8: Three dimensional presentations of variables at first optimum, (a) statement of disclosure-return assets, (b) statement of disclosure- ratio price to income, (c) return assets-ratio price to income-EPS, (d) ratio price to income-EPS, (e) statement of disclosure -EPS and (f) return assets-ratio price to income

Table 6: Fuzzy evaluation of TEPIX

TEPIXrepliers	Low	Medium	High	Total
1	0.014	13.097	7.622	20.738
2	0.025	22.920	2.540	25.480
...	...	...	...	...

Table 7: Absolute worth of the TEPIX

Repliers	Absolute worth
1	6.467767
2	5.394912
...	...

Table 8: Optimum value of linguistic variable

TEPIX	Statement of disclosure	Return assets	Ratio price to income	EPS	Optimum
7.67	6	8	6	7	Optimum

By last conclusion the absolute worth's of the research it is shown that research variables have the best condition to describe the model and it is described at in Table 7.

Therefore according to what ever is said research in local model is providing as shown in Fig. 7.

In other word between financial factors, return assets, EPS, ratio price to income and statement of disclosure variables have highest influence on TEPIX (Table 8). So, current results obtain by FuzzyTECH v.5.61 software.

According to whatever is said, 3D plot of research are shown in Fig. 8.

## DISCUSSION

Base on t-value and standard coefficients results between financial factors, EPS, ratio price to income, return assets and statement of disclosure variables are highest influence on TEPIX after each other (ratio price to income and return assets are same rank), so related to none-standard coefficients, EPS, statement of disclosure, ratio price to income and return assets variables are highest influence with structural equation model approach. Therefore, to make strong stock exchange and increasing the companies' value, it's suggested to the managers that using of new methods for access to more benefit and distributes it to forward growth price index.

In process of fuzzy modeling, we following to, linguistic variables fuzzy tools, fuzzy sets at linguistic variables, linguistic variables information, hypothesis and their confirmation, fuzzy inference linguistic variables, fuzzy evaluation, pattern's values for linguistics' variable, normalize and absolute value as show briefly in Fig. 9. These results showed in between factors,



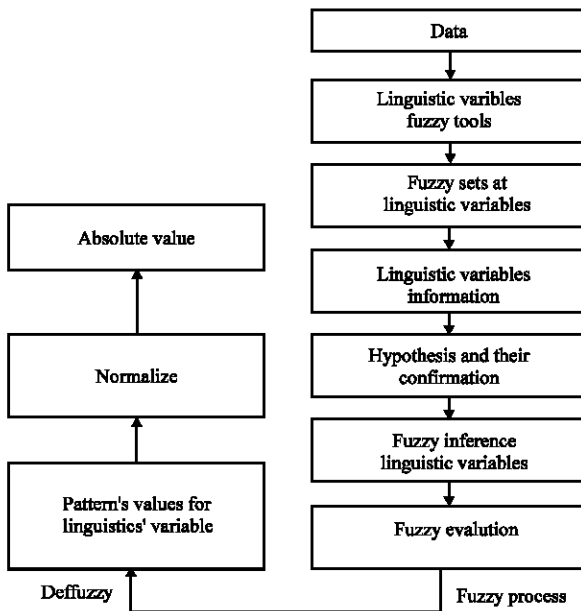


Fig. 9: Fuzzy modeling process

return assets, ratio price to income, statement of disclosure and EPS variables are highest effect on TEPIX after each other (ratio price to income and statement of disclosure are same rank). So, it is suggestion to the managers companies and especially financial managers that forwards Capital Company to increase of return assets projects. It can be help to the companies' economic growing and improving.

According to this research as it was explain completely, the result of some of these researches is compare with this research. Amirmozafari (2006) in her dissertation concluded, ratio price to income is affected on stock price index. Amiri *et al.* (2009) studied different effective variable on price index and confirmed it is effect on dependent variable, such as marketing, structure, management and especially finance. Chen and Zhang (2007) found that accounting factors can be prediction price stock movement. So, accounting factors are effective on stock price index. Starks and Wei (2004) concluded that disclosure of the most of the foreign currency may cause to financial problem in growing opportunities. Amiri *et al.* (2008) found EPS have effect on stock price index. Amiri *et al.* (2009) studied the effect of statement of disclosure on stock price index in ISE and confirmed this relation. So, all of the results was same to this study. We know that model needs to efficiency and effectiveness. So, efficiencies' key is comprehensive that related to providently and benefit that following nicety and precision in this research. An other astonish attribute of this study having same all variables researches in a

According to the presented documents of this study, these themes are as direction to further research: studying the other models of effective variable on stock price index with new techniques, priority and identify financial new instruments on stock exchange.

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