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Full Length Research Paper

Comparing linear and non-linear relationships between accounting variables and dividend: Evidence of Iranian chemical industries

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The aim of this study is to compare the linear and non-linear relationships between accounting variables and dividend of industrial chemical companies listed on the Tehran Stock Exchange from 2005 to 2010. Regression analysis is employed in order to test the existing relationship between variables and the significance of linear and non-linear models estimated. In this case, statistical tests like F and T are used for testing the research hypotheses. In this research, the quality of the relationship between the changes in the operating profit, net profit and cash flows resulted from the operations and dividends of the industrial chemical companies, and the significance of meaningful relationship or lack of meaningful relationship between the dependent and independent variables was estimated in 10 models.

Key words: Accounting variable, dividend, linear and non-linear relationships.

INTRODUCTION

For better decision-making by investors, and to ultimately improve the performance of securities, markets need to analyze the relationship between accounting information and other information as well as factors which affect decision-making (Salehi, 2008).

There is the need to evaluate the relationship between accounting information and other factors that can promote analysis in the stock exchange. No doubt, without extensive research and comprehensive data analysis, this market can- not expect increase in growth, performance and consequently the welfare of society as a whole (Salehi, 2009). A review of the history of the Tehran Stock Exchange shows that there has been a gap between the capital that consists of the main pillar of the market and that which controls the market. Finally, because most of the capital investors have little information about the companies they wish to invest their capital in, it is required to conduct a research that will provide investors with accurate information regarding investment criteria that will speed up decisions on the stock venture (Namazi and Salehi, 2010).

Research objective and problem

The research aims at providing powerful evidence of the impact of the variables - operating profit, net income and cash flows from operations on the stock returns of the industrial chemical companies studied when compared on the linear and non-linear models.

In addition, the study tries to provide model explanations for the effect of each of the selected variables on the previous and future stock price returns of the industrial chemical companies.

Based on the fact that the research considers the relationship between variables using already existing

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Table 1. Linear regression and nonlinear models.

Linear	$Y = \alpha + \beta x$
Semi logarithmic	$Y = \alpha + \beta Lnx$
Inverse	$Y = \alpha + \beta / x$
Quadratic	$Y = \alpha + \beta_1 x + \beta_2 x^2$
Cubic	$Y = \alpha + \beta_1 x + \beta_2 x^2 + \beta_3 x^3$
Compound	$Y = \alpha \beta^x$
Power	$Y = \alpha x^\beta$
S	$Y = \exp(\alpha + \beta / x)$
Growth	$Y = \exp(\alpha + \beta x)$
Exponential	$Y = \alpha e^{\beta x}$

information, it applies descriptive, and correlation methods. Again, the study analyzes the relationships between the variables using regression analysis.

LITERATURE REVIEW

Moramor and Kosta (1992), and Moramor and Pahor (1998) in their research examined the linear and non-linear relationships between existing stock returns and financial results reached. Omran and Ragab (2004) investigated the companies in Egypt, compared the linear and non-linear relationships between financial returns and stocks, and concluded that a linear and non-linear relationship is established between financial ratio and stock returns.

Millan (2001) in a study showed that the relationship between stock returns and variables that are non-linear can be converted to simple transactions based on the logarithmic-linear models. The variables that were considered in his study included the following: interest rates and the performance evaluation criteria such as income, equity returns and asset returns.

Karami et al. (2006) in their study entitled “Evaluation of Linear and Non-linear Relationships between Debt Ratios and Financial Returns in the Tehran Stock Exchange” considered profitability and market as independent variables and concluded that in addition to the linear and non-linear relationships between the variables, the intensity of this relationship was not strong and could not be reliable and could not account for more than 50% changes in stock returns.

Ghafari (2006) came to the conclusion that there is a weak relationship between the variables - operating profit, net income and cash flows, and the stock returns of the companies listed in the Tehran Stock Exchange. Hosseini (2008) concluded that a strong relationship exists between the variables.

However, in some cases, the non-linear relationship between the variables was able to explain the stock returns of the companies.

RESEARCH METHODOLOGY

Independent variables

The study included independent variables such as operating profit, cash flows from operations and net profit.

Dependent variable

The dependent variable is annual stock returns.

Population and sampling

The study population consists of all chemical companies listed on the Tehran Stock Exchange with respect to the following conditions:

1. Company financial year leading to the end of March each year.
2. Participation in the study period does not change the fiscal year.
3. Stocks in the period studied in the Tehran Stock Exchange are traded continuously.
4. Financial information, including notes along with the required financial statements in order to collect data for the variables is available for research. Companies that do not meet the above conditions of the population were statistically removed. Finally, the study sample after applying the above conditions was 21 companies.

Statistical tests and models of linear and non-linear regression

Using the regression and mathematical model, the relationship between the variables and the estimated and forecast deals are expected. In the Table 1, the linear and non-linear regression models applied to this study is depicted. In this model, the width of the source and the coefficient of the dependent and independent variables is x. The aim of this study is to compare the relationship between accounting variables and stock returns using the best fitted linear and non-linear model. All regression models with the width of the source and no source models were used to estimate the model’s latitude of source-free assumption which states that all variabilities are explained by the independent variables in the model, while the width of the source part of the dependent variable

Table 2. Regression results between dependent and independent variables.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F amount	Sig.	Test result of H_1
Linear	0.7040	0.036	-0.015	19	4.38	0.412	Rejected
Semi logarithmic	1.391	0.068	0.019	19	4.38	0.253	Rejected
Inverse	0.893	0.450	-0.005	19	4.38	0.356	Rejected
Quadratic	1.767	0.164	0.071	18	3.55	0.199	Rejected
Cubic	3.098	0.353	0.239	17	3.19	0.055	Accepted
Compound	0.324	0.017	-0.035	19	4.38	0.576	Rejected
Power	0.034	0.002	-0.051	19	4.38	0.856	Rejected
S	0.012	0.001	-0.052	19	4.38	0.913	Rejected
Growth	0.324	0.017	-0.035	19	4.38	0.576	Rejected
Exponential	0.324	0.017	-0.035	19	4.38	0.576	Rejected

Table 3. Regression results between dependent and independent variables.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F Amount	Sig.	Test results of H_1
Linear	5.744	0.223	0.184	20	4.35	0.026	Confirmed
Semi logarithmic	43.910	0.268	0.232	20	4.35	0.000	Confirmed
Inverse	7.327	0.268	0.232	20	4.35	0.014	Confirmed
Quadratic	14.788	0.609	0.568	19	3.52	0.000	Confirmed
Cubic	9.457	0.612	0.547	18	3.15	0.001	Confirmed
Compound	5.712	0.222	0.183	20	4.35	0.027	Confirmed
Power	148.76	0.881	0.878	20	4.35	0.000	Confirmed
S	17.763	0.470	0.444	20	4.35	0.000	Confirmed
Growth	5.712	0.222	0.183	20	4.35	0.027	Confirmed
Exponential	5.712	0.222	0.183	20	4.35	0.027	Confirmed

was explained by a fixed part described. Finally, according to the adjusted coefficient of determination for each regression model, the one that has the highest adjusted coefficient of determination (Adj.R^2) is selected as the best fitted for use.

To test the significance of the regression model, F-test and t-test were used, while to study the phenomenon of correlation between them, the error model of Durbin Watson test (DW) was used. The acceptable level of the test is 1.5 to 2.5, thus, all the variables in this study that were within the range of this statistical value were accepted. Therefore, there is no relationship between the independent variables or errors of each phrase.

Research hypotheses

Based on the objective of the study as well as its research problem, the following hypotheses were postulated for the study:

H_1: there is a significant relationship between changes in operational income and stock returns of Iranian chemical industries.
H_2: there is a significant relationship between stock returns and changes in net income of chemical industries in Iran.
H_3: there is a significant relationship between cash flow changes resulting from operations and stock returns chemical industries in Iran.

Regression testing between stock returns and operational profit ($\alpha \neq 0$)

Regression model test between operating income and stock returns in a state with a width of the source is presented in Table 2. In this test, operational income is taken as the independent variable while stock return is taken as the dependent variable. As can be seen in Table 2, the significance level is five per cent larger than the width of the state of origin, which implies that the first hypothesis is not confirmed and that the null hypothesis that there is no significant relationship between changes in operating income and stock returns in the chemical industries is accepted. Figure 1 shows the relation between operating income and share return.

Regression model tests between operating income and stock returns variables in width from the source without mode (a = 0)

As can be seen in Table 3, the significance level is

Table 4. Regression model of stock returns and net income.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F amount	Sig.	Test results of H_2
Linear	0.717	0.036	-0.014	19	4.38	0.408	Rejected
Semi logarithmic	0.943	0.047	-0.003	19	4.38	0.344	Rejected
Inverse	0.275	0.014	-0.038	19	4.38	0.606	Rejected
Quadratic	1.911	0.175	0.084	18	3.55	0.177	Rejected
Cubic	3.637	0.319	0.283	17	3.19	0.034	Accepted
Compound	0.322	0.017	-0.035	19	4.38	0.575	Rejected
Power	0.000	0.000	-0.053	19	4.38	0.989	Rejected
S	0.027	0.001	-0.051	19	4.38	0.872	Rejected
Growth	0.322	0.017	-0.035	19	4.38	0.575	Rejected
Exponential	0.322	0.017	-0.035	19	4.38	0.578	Rejected

Table 5. Regression model of stock returns and net income.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F amount	Sig.	Test results of H_2
Linear	5.244	0.208	0.168	20	4.35	0.033	Confirmed
Semi logarithmic	43.239	0.684	0.666	20	4.35	0.000	Confirmed
Inverse	7.791	0.280	0.244	20	4.35	0.011	Confirmed
Quadratic	13.818	0.593	0.550	19	3.52	0.000	Confirmed
Cubic	8.790	0.594	0.527	18	3.15	0.001	Confirmed
Compound	5.084	0.203	0.163	20	4.35	0.036	Confirmed
Power	142.58	0.877	0.871	20	4.35	0.036	Confirmed
S	16.700	0.455	0.427	20	4.35	0.001	Confirmed
Growth	5.084	0.203	0.163	20	4.35	0.036	Confirmed
Exponential	5.084	0.203	0.163	20	4.35	0.036	Confirmed

five percent smaller than the width of the state, so in this condition, as it is indicated by the first hypothesis, there is a significant relationship between changes in operational income and stock returns in the chemical industries. Figure 2 shows operating income and stock returns.

Regression model tests between net income and stock returns in a state with a width of the source ($\alpha \neq 0$)

Regression model tests between net income and stock returns in a state with a width of the source ($\alpha \neq 0$) are presented in Table 4. The net income is taken as independent variable while stock return is taken as the dependent variable in Table 4. As can be seen in the table, the significance level is confirmed in all cases except cubic which is greater than five per cent of the state of origin with a width in the second H_0. The cubic regression model level of significance of five per cent is smaller than 34%, so it is only for this case that the H_2 is confirmed. Figure 3 shows the net income and stock returns.

Regression model tests between net income and stock returns within the state without the source (a = 0)

Regression model tests between net income and stock returns within the state without a source (a = 0) are presented Table 5. In this test, net income is taken as independent variable and stock returns as the dependent variable. As can be seen in the table, the significance level is smaller than five per cent, so the second hypothesis is accepted while the null hypothesis is rejected. In other words, there is a significant relationship between stock returns and changes in the net income of the chemical industries. Figure 4 shows the net income and stock returns within the state without the source.

Regression models between cash flows from operations and stock returns in a state with a width of the source ($\alpha \neq 0$)

Test results between the regression model variables cash flows from operations and stock returns in a state with a

Table 6. Regression model of stock returns and cash flows.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F amount	Sig.	Test results of H_3
Linear	0.609	0.031	-0.020	19	4.38	0.445	Rejected
Semi logarithmic	1.027	0.051	0.001	19	4.38	0.324	Rejected
Inverse	0.012	0.001	-0.052	19	4.38	0.915	Rejected
Quadratic	3.317	0.269	0.188	18	3.55	0.059	Rejected
Cubic	4.316	0.432	0.332	17	3.19	0.020	Accepted
Compound	0.420	0.022	-0.030	19	4.38	0.525	Rejected
Power	0.014	0.001	-0.052	19	4.38	0.906	Rejected
S	0.434	0.022	-0.029	19	4.38	0.518	Rejected
Growth	0.420	0.022	-0.030	19	4.38	0.525	Rejected
Exponential	0.420	0.022	-0.030	19	4.38	0.525	Rejected

Table 7. Regression model of stock returns and cash flows.

Regression model	F statistic value	Coefficient of determination	Adjusted coefficient of determination	D.f	F Amount	Sig.	Test results of H_3
Linear	4.153	0.172	0.131	20	4.35	0.055	Rejected
Semi logarithmic	43.422	0.685	0.669	20	4.35	0.000	Accepted
Inverse	7.828	0.281	0.245	20	4.35	0.011	Accepted
Quadratic	18.107	0.656	0.620	19	3.52	0.001	Accepted
Cubic	11.644	0.660	0.603	18	3.15	0.000	Accepted
Compound	4.175	0.173	0.131	20	4.35	0.054	Rejected
Power	144.873	0.879	0.873	20	4.35	0.000	Accepted
S	13.644	0.46	0.376	20	4.35	0.001	Accepted
Growth	4.175	0.174	0.132	20	4.35	0.054	Rejected
Exponential	4.176	0.173	0.131	20	4.35	0.054	Rejected

width of the source ($\alpha \neq 0$) are presented in Table 6. In the test, cash flows from operations is considered as an independent variable while stock returns is considered as the dependent variable. As can be seen in the table, significance level in all cases except Cubic is greater than five per cent and the H_0 of the third hypothesis within the state without source width is confirmed, while the research hypothesis is rejected. That is, there is no significant relationship between cash flow changes resulting from operations and stock returns in the chemical industries. Figure 5 shows the relation between cash flows and stock returns in a state with a width of the source.

Regression model between cash flows from and stock returns within the state without the source (a = 0)

Test results of regression models between cash flows from and stock returns within the state without a source (a = 0) are presented in Table 7. In this test, cash flows is considered as the independent variable while stock returns is taken as the dependent variable. As can be seen in Table 7, in no case within the source of the regression models of Linear, Compound, Growth, and Exponential is the significant level (Sig) obtained greater than five per cent other than the third hypothesis of these models where H_0 is accepted and H_3 is rejected. In other words, a meaningful relationship does not exist between the variables - cash flows from operations and stock returns without a mode width of the source. Again, in the models - Semi Logarithmic, Inverse, Quadratic, Cubic, Power, and S, given that the significant level obtained was less than five per cent in the third hypothesis, H_0 is rejected while H_3 is confirmed. Figure 6 reveals the relation between cash flows from and stock returns within the state without the source.

DISCUSSION

Based on the findings of this study, the linear and non-linear relationships between accounting variables and

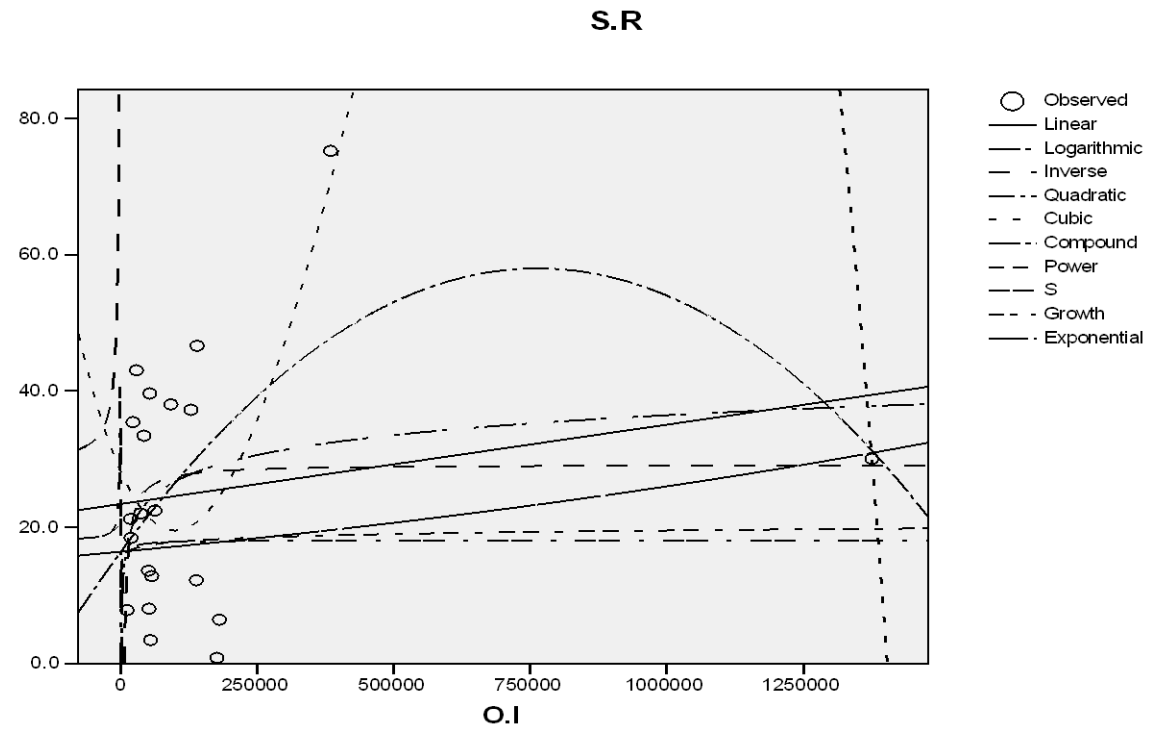

Figure 1. Regression graph between operating income and return shares in a state with a width of the source.

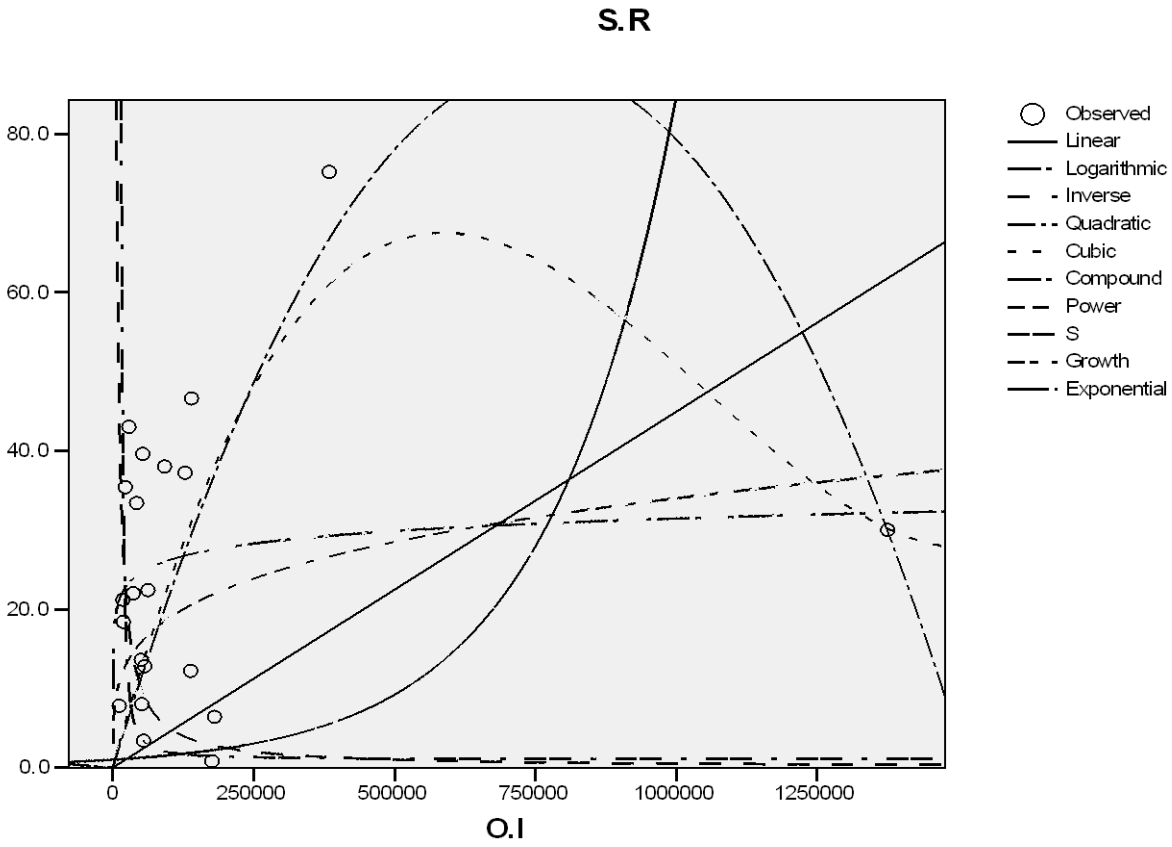

Figure 2. Regression graph between operating income and Stock returns within the state without the source.

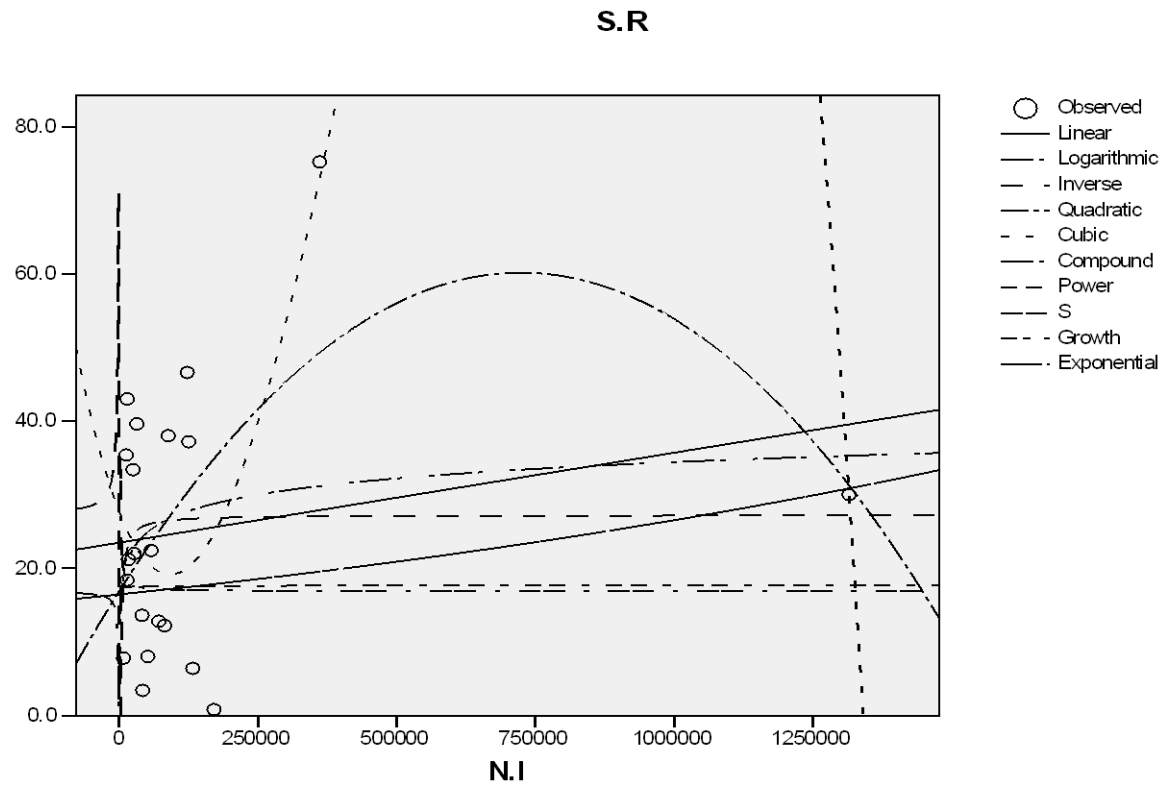

Figure 3. Variable regression graph between net income and stock returns in a state with a width of the source.

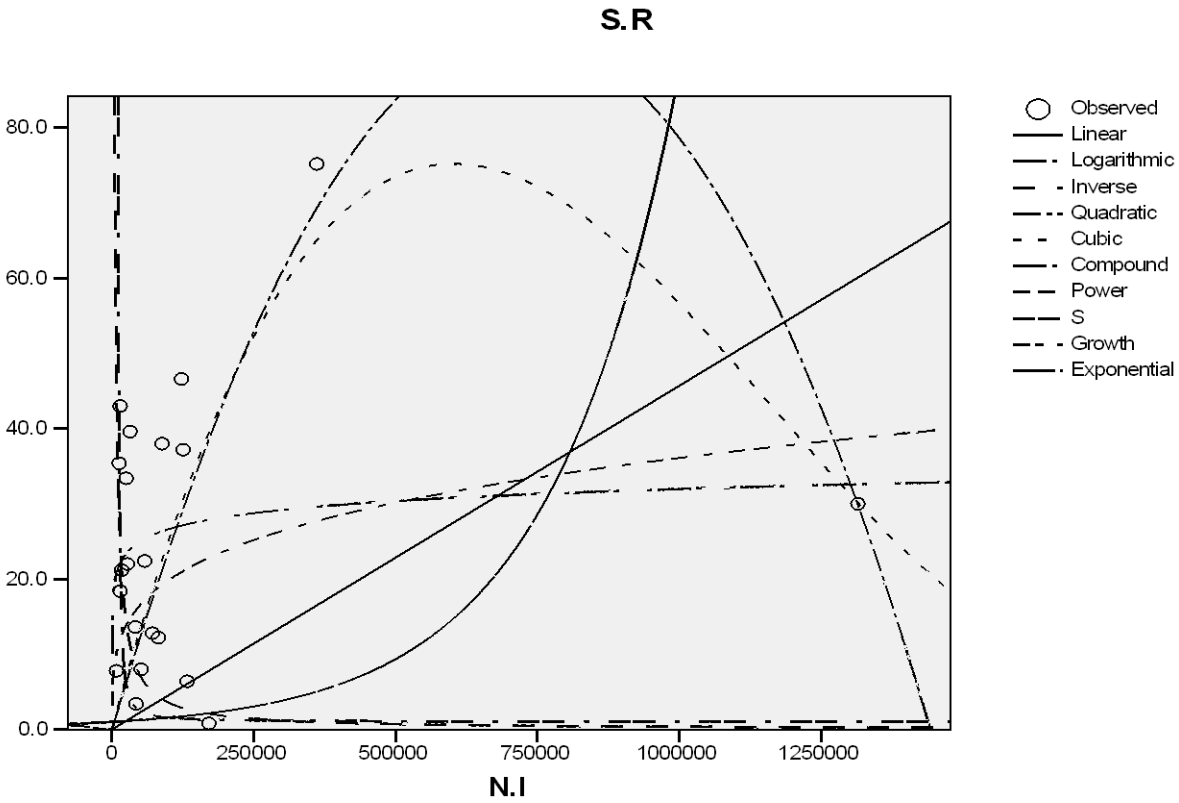

Figure 4. Regression graph between net income and Stock returns within the state without the source.

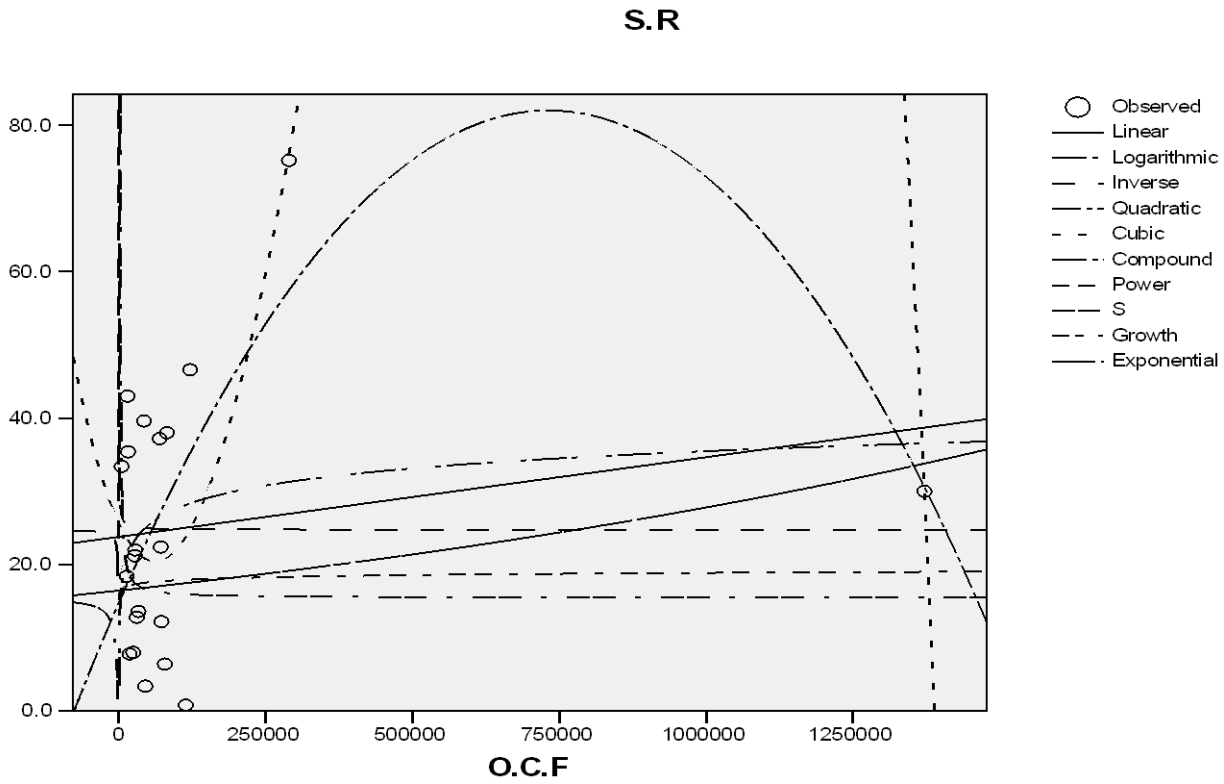

Figure 5. Regression diagram between cash flows and stock returns in a state with a width of the source.

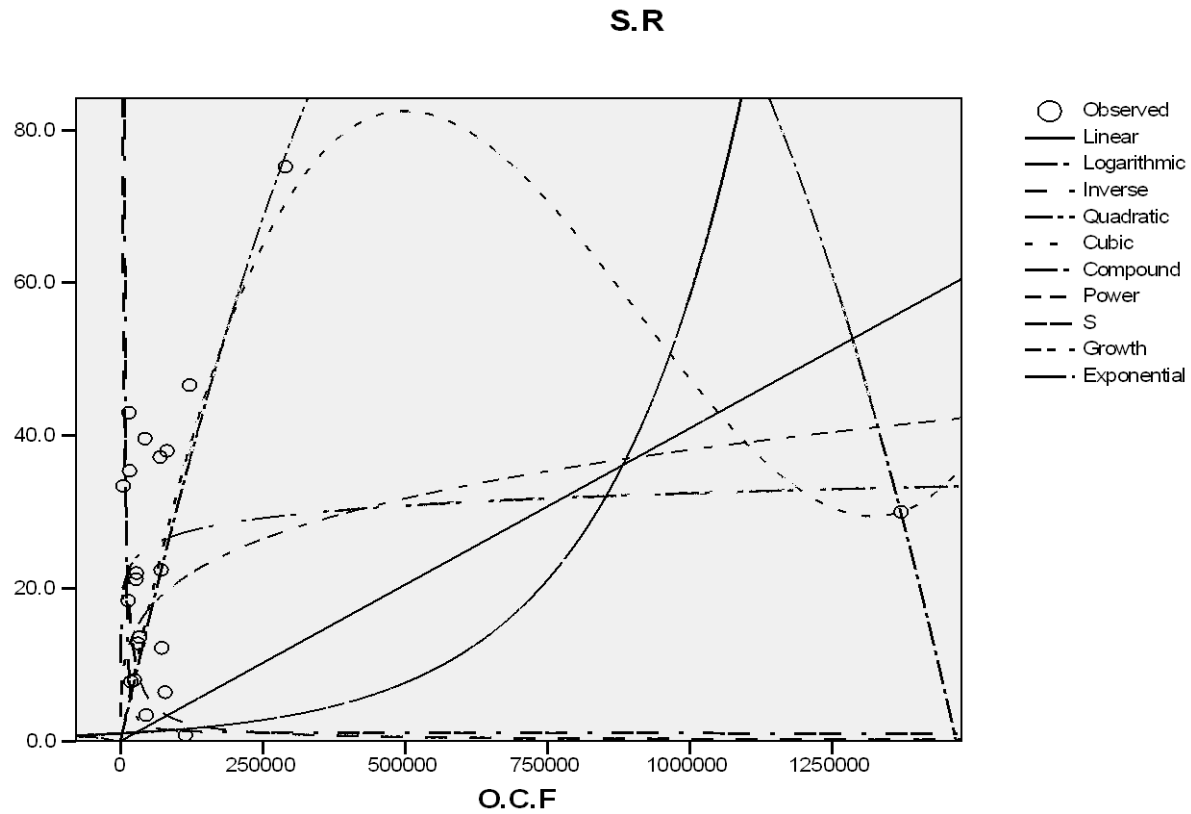

Figure 6. Regression diagram between cash flows from and stock returns within the state without the source.

stock returns of the industrial chemical companies is strong and can be used as reliable information. However, the non-linear relationship between accounting variables and stock returns is stronger than the linear relationship between them. In some cases, 95% of the variables were able to explain stock returns. In this study, though the non-linear relationship between accounting variables and stock returns is strong, the role of other factors used in decision-making cannot be ignored. Economic factors which include exchange rate, inflation and employment rates; political and cultural factors certainly influence the decision-making of prospective capital investors. In this regard, the cognition of the behavior of stocks and the overall decision-making of capital investors are still unclear.

Considering the important role of the relationship discovered between accounting variables and stock returns, economic investment decision-makers will help the Tehran Stock Exchange to formally announce its annual returns.

CONCLUSION AND REMARKS

In this study, we tried to find out the best fitted linear and non-linear model with which to express the relationship between accounting variables and stock returns of chemical industries in Iran. The linear and non-linear relationships between these variables were tested to evaluate the significance of linear and nonlinear regression models. In order to choose the best fitted type of linear and non-linear models, the model that had the highest adjusted coefficient of determination (Adjusted R^2) was chosen. In this study, the value of the dependent variable, stock returns, is shown as a percentage of that determined by the independent variables described.

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